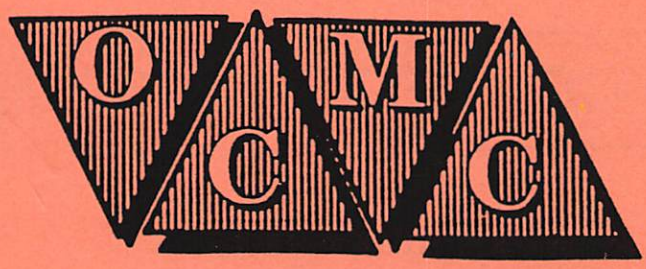

The Orange County Mathematics Council

Presents the

8th Annual Conference

Irvine High School

Irvine, California

October 1, 1994

OCMC Officers

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President-Elect:	Juanita Walker
Vice President:	Jerry White
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Pio Pico Elementary School
931 W. Highland
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(714) 558-5608

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9-12 Jerry White

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Orange County Mathematics Council

AN AFFILIATE OF THE CALIFORNIA MATHEMATICS COUNCIL - SOUTHERN SECTION

Hi Math Enthusiasts!

Welcome to Orange County Mathematics Council's Eighth Annual Conference! We anticipate your complete enjoyment of this conference and look forward to greeting each of you on the beautiful campus of Irvine High School. We know that you recognize the importance of working together to provide the best possible learning environments for all of our students.

This spring, in response to the 1992 California Mathematics Framework, many publishers submitted new instructional materials to the State Department of Education for their approval and adoption for K-8 Instruction. Therefore it is a critical time for us as math educators to take a good look at *what* we are teaching and *how* we are teaching it, so we can find matches with the new instructional materials, and choose those that fit our needs for adoption by our own districts. In this light, the theme for this year's conference is "Instructional Materials: The Choice is Yours".

Many of your friends and colleagues from all over Orange County have been working very hard to make this the best conference yet. We want you to know that this is <u>your</u> conference and we really want your input (and your help) to keep improving every year.

You asked for more presentations for primary grades. You got it! We have added at least one primary session at every time slot, and sometimes as many as three additional selections. You asked for longer sessions. You got it! This year we have extended the session just before lunch to 85 minutes. That will give you enough time to actually do the activities, and reflect on your learning in addition to receiving some great tips on motivating your students to learn. You asked for more exhibitors. You got it! I hope your favorite publisher is here, with all the materials you need to start the year off right! Please continue to let us know your wishes, and we will try to meet them.

Go out there and enjoy!!

Juanita R. Walker

Juanita Walker
8th Annual Conference Chair

Conference Information

THE EIGHTH ANNUAL OCMC CONFERENCE will be held on Saturday, October 1, 1994, at Irvine High School, located at 4321 Walnut Avenue in Irvine.

PRE-REGISTRATION deadline is September 23, 1994. Use the registration form in this program (or duplicate). Fees are indicated on the form. Pre-registrants may pick up their packets of materials in the Registration Area. Please bring this program with you to the conference.

REGISTRATION will be held at the Student Center (see map on previous page) between 8:00 a.m. and 12:00 noon on Saturday, October 1, 1994. Participants may pick up their packets at this time.

REGISTRATION FEES

	Pre-registration	On-site
Conference Registration (includes membership)	$25.00	$35.00
Speaker	0	0
OCMC Membership (good from 10-1-94 to 9-30-95)	$10.00	$10.00
CMC Membership	$20.00	$20.00

REFUND of the pre-registration fee will be granted only upon written request mailed and postmarked before October 8, 1994.

SESSIONS will consist of three 55 minute sessions and one 85 minute session. There are no admission tickets, but seating is limited to the capacity of the room.

EVALUATION cards will be distributed at each session. Please complete one card for every session you attend and give it to the session presider.

HOSPITALITY consisting of coffee and donuts (provided by the Publishers who are exhibiting) will be available in the registration area.

RECOMMENDED PARKING is the lot in front of the school off Walnut Avenue. Additional parking can be found off Escolar Street.

Keynote Speakers

KEYNOTE SPEAKER (ELEMENTARY)
8:30 - 9:25

Room: Theater

Speaker: **Judy Anderson**
Past President, California Math Council Southern Section
Mathematics Specialist at Riverside County Office
Teaching Consultant, State Department of Education

MATHEMATICS POWER FOR ALL . . .
How do our lessons look when we provide students the opportunity to do the thinking?

KEYNOTE SPEAKER (SECONDARY)
9:40 - 10:35

Room: Theater

Speaker: **Randall Charles**
Professor of Mathematics
San Jose State University
Nationally Known Author

ARE YOU LIVING WITH DINOSAURS?
It's time to abandon or de-emphasize some traditional content and instructional practices in secondary school mathematics. What can go? What should stay? What should stay but look different? Let's talk about change at a time when ALL students are supposed to take college-prep classes.

OCMC Conference Schedule
Saturday, October 1, 1994

ELEMENTARY (K-8)

8:00 - 8:30	Registration and Refreshments
8:30 - 9:25	Judy Anderson, Keynote Speaker
9:25 - 10:00	Visit the Exhibits
10:00 - 10:55	Session I
11:05 - 12:30	Session II (extended session)
12:30 - 1:30	Complimentary Lunch
1:30 - 2:25	Session III
Closing Session	Closing Remarks and Door Prizes
2:30 - 3:00	Juanita Walker, Theater

SECONDARY (6-12)

8:00 - 8:30	Registration and Refreshments
8:30 - 9:25	Session I
9:40 - 10:35	Randall Charles, Keynote Speaker
10:35 - 11:05	Visit the Exhibits
11:05 - 12:30	Session II (extended session)
12:30 - 1:30	Complimentary Lunch
1:30 - 2:25	Session III
Closing Session	Closing Remarks and Door Prizes
2:30 - 3:00	Juanita Walker, Theater

Session I 8:30 - 9:25 (Secondary)

Room: 1 **6-8**

Speaker: **Ana Golan**, State Department of Education

Replacement Units
Get some ideas for making sense of the middle school mathematics curriculum.

Room: 2 **6-8**

Speaker: **Ernie Dawe**, Desert Springs USD

Probability With Area Models
Through the use of the MGMP materials we will explore concrete ways to look at probability.

Room: 3 **6-8**

Speaker: **Pat Cohen, Ed.M.**, UCI Consultant

Light and Natural Logic for Pre-Teens
Take an easy-going "guide on the side" teaching approach with these problem-solving workbook examples of matrix logic, syllogisms and Venn diagrams.

Room: H2 **6-8**

Speaker: **Delia Benn**, Santa Ana USD
Charles P. Waterman, Santa Ana USD

Wanna Bet
A cooperative probability problem solving game using manipulatives.

ELEMENTARY
8:30 - 9:25
Keynote Speaker
JUDY ANDERSON is in the Theater.

Room: 6 **6-8**

Speakers: **Cary Henderson**, Santa Ana USD
Alma Williams, Santa Ana USD

Math: Critical Thinking for All Students
See how you and your students can explore higher level thinking skills through hands-on activities, i.e. place value, measurement, proportion, statistics and permutations.

Help yourself to the morning snacks provided by the exhibitors.

Room: 4 **8-11**

Speaker: **Don Houser**, Fullerton USD

Graphs That Connect
Traditional textbook graphing is usually so sterile. Experience some activities that will make graphs connect with real life.

Room: 5 **8-12**

Speaker: **Sybilla London**, Inglewood USD

Concrete Geometry - The Big Connection
Use coordinate geometry as a connection with algebra and many aspects of geometry.

Room: 10 **8-12**

Speaker: **Dianne Camacho**, Orange County Department of Education

SCRAP - Algebra and Geometry
An overview of the Southern California Regional Algebra Project which provides teachers a transitional approach to begin implementing the recommended curriculum changes using replacement units in Algebra and Geometry.

Session I 8:30 - 9:25 (Secondary)

Room: 7 **9-12**

Speaker: **Barbara Post**, Garden Grove USD

Discovering Volume & Surface Area in Geometry
Participants will make models and discover the volume and surface area of prisms, pyramids, cylinders & cones.

Room: 8 **9-12**

Speaker: **David Armstrong**, Huntington Beach USD

Algebra/Geometry Experiments and Projects
Discover the wonderful experience attached to class projects and/or experiments. Student examples will be shown.

Room: 9 **9-12**

Speaker: **Cam Peterson**, Anaheim USD

Teaching Integrated Mathematics
A hands-on session in which participants will experience how Integrated Math: Course I is being taught through explorations and math modeling at Kennedy High School.

SECONDARY
9:40-10:35
Keynote Speaker
RANDALL CHARLES
is in the Theater.

ELEMENTARY
9:25 - 10:00
Time to Visit the Exhibitors

Room: H3 **K-12**

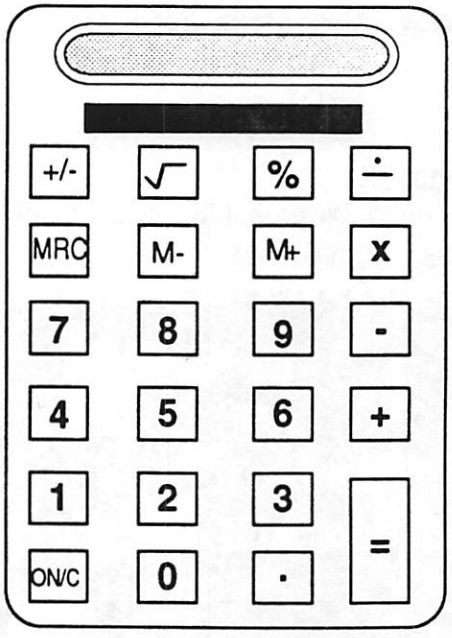
Speakers: **Marelle Dorsey**, Garden Grove USD
Thelma Anselmi, Diocose of Orange

Now That You Know What to Teach, How Do You Teach It?
Attend an interactive presentation of the new NCTM Professional Standards for Teachers.

Room: 11 **11-Coll**

Speaker: **Harris Shultz**, California State University of Fullerton

TI-81/TI-82 Introduction to Calculus
Bring your TI-81 or TI-82 and learn how beginning calculus can be approached using a graphing calculator.



Session I 10:00-10:55 (Elementary)

Room: 2 **K-2**

Speaker: **Cristina Garcia**, Santa Ana USD

Math Investigation & Beyond
What do math investigations look like in the primary grades? What are the components of a math investigation? Come and see how they can work in you own classroom.

Room: 5 **K-2**

Speaker: **Cathy Parker**, Los Alamitos USD

Journal Writing Ideas
Speaker will moderate a group discussion on using journal writing to solve problems. Teachers are encouraged to bring ideas to share.

Room: 10 **K-2**

Speakers: **Tracy Barquer**, Capistrano USD
Jami Castner, Capistrano USD

Primarily Calculators
The use of calculators is a fun and exciting way for children to explore number sense and mathematical thinking. This workshop offers primary teachers ideas on ways to implement the use of calculators in their math curriculum. Materials provided.

Room: 11 **K-3**

Speakers: **Lisa M. Reid**, Irvine USD
Freddi-Lynn Siegel, Irvine USD

Managing Your Math Class Without a Text
Organize resources into units crossing all strands. Use concrete manipulatives leading to abstract applications. Learn how to use writing in mathematics and make extensions to other curricular areas.

Room: 3 **1-3**

Speaker: **Lou Ann Rawls**, Capistrano USD

Star Dazzling Math
Activities will be presented that will enhance geometrical thinking, spatial awareness and number sense using a "STAR" theme. Teachers will receive ready to use materials for immediate classroom use.

Room: 6 **1-3**

Speaker: **Cherlyn Converse**, California State University of Fullerton

Get Your "Hands-on" Logic
Ideas on using hands-on methods of teaching logic math and word problems at the 1st through 3rd grade level will be presented. These ideas make word problems a positive experience.

Room: 1 **K-1**

Speaker: **Kathleen Stanton**, Santa Ana USD

Math Games
Make-it, take-it workshop. Pick up a few games to enhance your math program. Bring one dollar a game to cover costs.

Young children are active individuals who construct, modify, and integrate ideas by interacting with the physical world, materials, and other children.
NCTM Standards

Session I 10:00-10:55 (Elementary)

Room: 7 **2-4**

Speaker: **Shelley Overstreet**, Capistrano USD

Create a Math Lab

Learn how to create and manage a math lab experience for your students. You will receive several ideas of games and activities reflecting the math framework and discover how to organize them into an exciting math period.

Room: 4 **2-5**

Speakers: **Jill Brimmer**, Santa Ana USD
Lydia Cruz, Santa Ana USD

Shapes, Tessellations and Perimeter Measurement

Enjoy a fun-filled potpourri of classroom tested ideas in shape investigations! Learn how to teach your students the concept of measurement through the use of easy-to-find manipulatives.

Room: H2 **2-5**

Speaker: **Dee Harmon,** Santa Ana USD

Write-On Math

Let's experiment with some hands-on math assignments that can promote writing and thinking and lead to authentic assessment.

The very act of communicating clarifies thinking and forces students to engage in doing mathematics.
NCTM Standards

Room: H4 **2-5**

Speakers: **Pamela Manke**, Santa Ana USD
Trish DeMilt, Santa Ana USD

Tan is More Than a Color

Integrate literature into your math program through the study of tangrams! Create your own set of tangrams to link up with Grandfather Tang's Story. Increase your students' comprehension of mathematical language while investigating geometrical properties associated with this ancient game.

Room: H3 **3-6**

Speakers: **Judy McLeod**, Westminster USD
Delores Rice, Westminster USD

How to Become a Winner!

Is it luck or is it skill? Cooperation in games and strategies = everyone wins! Learn how games connect to the mathematics of language and logic.

Room: 8 **3-6**

Speaker: **Tina Harvey**, Santa Ana USD

Reducing Fractions: The Easy Way

If you're having trouble teaching your students to reduce fractions, this is the workshop for you! Any student having trouble with this important skill will benefit from this step-by-step approach. Reinforces multiplication, division, and patterns, too!

Room: 9 **4-6**

Speaker: **JoAnn Merrill**, San Juan Capistrano Research Institute

Stars, Planets, and Math

A thematic unit integrating astronomy and math. Come reach for the stars!

Session II 11:05-12:30

Room: 4 **K-2**

Speaker: **Marylou Miller**, Fullerton USD

Who's Afraid of the Big Bad Math
Let's "pig out" on math using the strands including number, estimation, measurement, patterns, logic, and discrete math integrated with language arts, art, and music.

Room: 2 **K-2**

Speaker: **Lynn Inch**, Ocean View USD

Medal Math - The Next Chapter
The 1994-95 books nominated for the primary California Young Reader Medal Award will be integrated with the mathematics framework, emphasizing problem solving techniques.

Room: H3 **K-3**

Speaker: **Pam Thomas**, Santa Ana USD

How Many Triangles?
A series of activities designed to introduce the concept of area using problem-solving and cooperative learning.

Room: 1 **1-4**

Speaker: **Kathleen Stanton**, Santa Ana USD

Math Games
Make-it, take-it workshop. Pick up a few games to enhance your math program. One dollar a game to cover costs.

Room: 6 **1-3**

Speakers: **Dionne Dargabus**, Capistrano USD
Cara Calentino, Capistrano USD

Probability and Statistics
Come roll a die, flip a coin, look inside a peek box and take a survey. The probability is high that you will come away from this workshop with some new ideas and fun books for integrating this strand of the framework into your program.

Room: 5 **3-5**

Speaker: **Linda Barker**, Laguna Beach USD

Up, Up, and Away With Geometry
Enrich your geometry unit with "hands-on" activities for individuals and for cooperative groups. Learn how to make tetrahedron kites, tessellations, 3-D shapes and boxes. Take home activities to make your geometry unit come alive!

Teachers need to create an environment that encourages children to explore, develop, test, discuss, and apply ideas.
NCTM Standards

Session II 11:05-12:30

Room: 7 **3-5**

Speakers: **Cindi Hausheer**, Saddleback Valley USD
Nancy Cangiano, Ocean View USD

Exploring With Cuisenaire Rods
(Roddles, Geometry, Math Arrays, and Equations) Use Cuisenaire rods to integrate a variety of math strands. Activities address the new math framework.

Room: H20 **3-6**

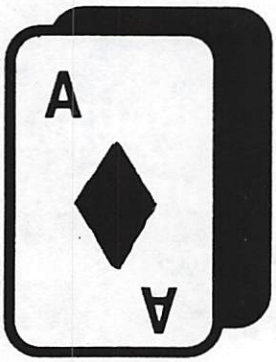
Speaker: **Juanita Walker**, Santa Ana USD

Make Math Meaningful
Engage students in long-term, real-world projects. Tips for teaching math concepts in a thinking-meaning-centered curriculum.

Room: H19 **6-7**

Speaker: **Sally Melton**, Santa Ana USD
Dennis McGeeney, Santa Ana USD
Rob McDonald, Santa Ana USD

Deal Me In
Cards have unlimited possibilities for visual efficiency, principle of sorting and grouping, logic planning and mental alertness. Come let three experienced card sharks show you a trick or two.



Once students learn to rely on procedures, they tend to give up on common sense.
The Mathematics Report Card

Room: H4 **4-8**

Speaker: **Robin Palmer**, Capistrano USD

Math Investigations
Take part in written investigations which encourage students to go from problem solving to problem posing. Activities will include "Hanukkah Candles", "Twelve Days of Christmas" and The King's Chessboard.

Room: H2 **6-8**

Speaker: **Bob Hamada**, Los Angeles USD

Mathematical Problems and Investigations
Participants will explore short investigations that will help their students learn, enjoy and feel powerful about mathematics.

Room: 3 **6-8**

Speaker: **Beth Andrini**, Santa Ana USD

A Touch of CLAS
Preparing for the CLAS test can be a fun, hands-on experience for grades 6-8. Enjoy a "touching" experience in this CLAS!

Room: 8 **6-10**

Speaker: **Kay McFall**, Westminster USD

Teaching Math Through Art Activities
Discover a hands-on approach to teaching math through paper folding and line art. Unfold a positive attitude towards math and motivate the most reluctant learner.

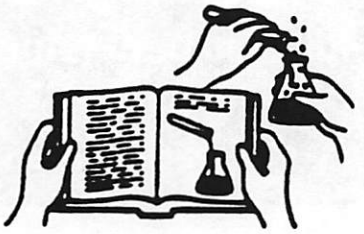
Session II 11:05-12:30

Room: 10 **7-12**

Speaker: **Jerry White**, Santa Ana USD

Math/Science Investigations

Experience engaging problems that make connections by integrating math and science lessons.



Room: 9 **9-12**

Speaker: **Janice Shultz**, Irvine USD

Sewer Covers

Curves of constant width, called Reuleaux polygons, will be investigated using basic geometric constructions.

Room: 11 **9-12**

Speaker: **Richard Glick**, Capistrano USD

Enhancing the Curriculum With Graphing Calculators

Teachers will be shown how to use the TI-82 graphing calculator. No prior experience with technology is necessary.

Problem solving is not a distinct topic but a process that should permeate the entire program and provide the context in which concepts and skills can be learned.

NCTM Standards

COMPLIMENTARY LUNCH FOR ALL

IN THE COMMONS AREA

12:30 - 1:30

Session III 1:30 - 2:25

Room: 1 **K-3**

Speakers: **Jessica Banda**, Santa Ana USD
Linda McGaugh, Santa Ana USD

A Different Approach to Geometry
Teachers will leave with new, hands-on ideas for incorporating Geometry into daily lessons. CLAS preparation, ELD, oral language experience and mathematical writing development ideas will be provided.

Room: 2 **1-3**

Speaker: **Betsy Finn**, Capistrano USD

"Time Out" in Mathematics
Enrich and enlighten your students with different aspects of the measurement of time. Teachers will receive ideas and materials for immediate classroom use.

Room: 3 **1-4**

Speakers: **Helene Dykes**, Capistrano USD
Barbara Hollis, Capistrano USD

Creepy Crawlies - An Integrated Unit
An integrated, hands-on unit on bugs with problem solving activities in all math framework strands. Participants receive all hand-outs necessary to implement this unit in their classrooms.

Room: 11 **3-6**

Speaker: **Dave Dunbeck**, Capistrano USD

The Art of Geometry: An Architectural Simulation
Teach students how to apply the principles of geometry to art and design. Students actually draw blueprints and then build and decorate a model house. This unit integrates all math operations, as the students write a realistic estimate of construction costs. Great for ongoing instruction or final projects.

Equity for all students requires a full range of opportunities that can stimulate each person to tap fully his or her interests and capabilities.
Everybody Counts

Room: 4 **4-6**

Speaker: **Melinda Bungartz**, Capistrano USD

Bringing Writing Into Your Math Classroom
Get your students accurately expressing their mathematical ideas in writing, whether it be for journal writing, ongoing assessment, or the CLAS test.

Room: 5 **5-8**

Speakers: **Kim Hayes**, Capistrano USD
Dave Chamberlain, Capistrano USD

The Math Connection Between Elementary and Middle Schools
Gain insights into teaching strategies, hands-on activities, and new curriculum now in use at middle and elementary schools. Find creative ways to implement great lessons from other grade levels into your classroom.

Room: 7 **7-8**

Speaker: **Louis McCreery**, Bonita USD

Wouldn't It Be Loverly...Loverly
Beginning algebra will be shown as a relevant course that can be used in students' lives. The course helps generate interesting investigations.

Session III 1:30 - 2:25

Room: 6 **7-12**

Speaker: **Beth Hillger**, Fullerton USD

Projects and Ideas for Geometry and Algebra
Get students actively involved in using math skills.

Room: 8 **7-12**

Speaker: **Roger Enge**, Saddleback Valley USD

Decision Time: To Use Calculator, Head or Paper
Experience some unusual calculator, head, and paper techniques for secondary math students.

Room: 10 **8-12**

Speaker: **D.P. Jim Prekeges**, Houghton Mifflin Company

Quickie Explorations Develop Understanding
Explorations by students enhance learning and produce better understanding. Examples will be presented.

Room: 9 **K-12**

Speaker: **John Leonard**, Los Alamitos USD

Revealing Research
If you have been teaching for over three years, you may be ready to start creating a classroom climate for understanding. What does research say?

Exhibits close at 2:00

DRAWINGS for DOOR PRIZES in the THEATER 2:30-3:00

Keynote Speaker Notes

see scribble

Session I Notes

See handout

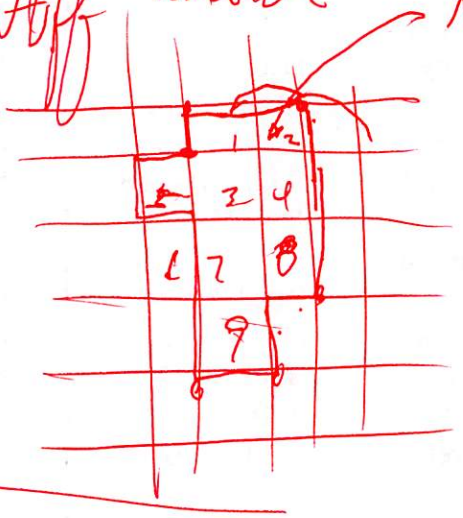
Session II Notes

Session III Notes

Carl Harvey → full inclusion

both started = How many

w/ grid | Area = stuff inside
Perimeter = stuff outside



Area
ADD

PERIMETER

64
20
48
63
66

② Book Rhyme
① Poem & cutout
② Animal ~~and~~

favorite shape

Speakers

Last Name	First Name	Time	Room
Anderson	Judy	8:30	Theater
Andrini	Beth	11:05	3
Anselmi	Thelma	8:30	H3
Armstrong	David	8:30	8
Banda	Jessica	1:30	1
Barker	Linda	11:05	5
Barquer	Tracy	10:00	10
Benn	Delia	8:30	H2
Brimmer	Jill	10:00	4
Bungartz	Melinda	1:30	4
Calentino	Cara	11:05	6
Camacho	Dianne	8:30	10
Cangiano	Nancy	11:05	7
Castner	Jami	10:00	10
Chamberlain	Dave	1:30	5
Charles	Randall	9:40	Theater
Cohen	Pat	8:30	3
Converse	Cherlyn	10:00	6
Cruz	Lydia	10:00	4
Dargabus	Dionne	11:05	6
Dawe	Ernie	8:30	2
DeMilt	Trish	10:00	H4
Dorsey	Marelle	8:30	H3
Dunbeck	Dave	1:30	11
Dykes	Helene	1:30	3
Enge	Roger	1:30	8
Finn	Betsy	1:30	2
Garcia	Cristina	10:00	2
Glick	Richard	11:05	11
Golan	Ana	8:30	1
Hamada	Bob	11:05	H2
Harmon	Dee	10:00	H2
Harvey	Tina	10:00	8
Hausheer	Cindi	11:05	7
Hayes	Kim	1:30	5
Henderson	Cary	8:30	6
Hillger	Beth	1:30	6
Hollis	Barbara	1:30	3
Houser	Don	8:30	4
Inch	Lynn	11:05	2
Leonard	John	1:30	9
London	Sybilla	8:30	5

Last Name	First Name	Time	Room
McCreery	Louis	1:30	7
McDonald	Rob	11:05	H19
McFall	Kay	11:05	8
McGaugh	Linda	1:30	1
McGeeney	Dennis	11:05	H19
McLeod	Judy	10:00	H3
Manke	Pamela	10:00	H4
Melton	Sally	11:05	H19
Merrill	JoAnn	10:00	9
Miller	Marylou	11:05	4
Overstreet	Shelley	10:00	7
Palmer	Robin	11:05	H4
Parker	Cathy	10:00	5
Peterson	Cam	8:30	9
Post	Barbara	8:30	7
Prekeges	D.P. Jim	1:30	10
Rawls	Lou Ann	10:00	3
Reid	Lisa M.	10:00	11
Rice	Delores	10:00	H3
Shultz	Harris	8:30	11
Shultz	Janice	11:05	9
Siegel	Freddi-Lynn	10:00	11
Stanton	Kathleen	10:00	1
Stanton	Kathleen	11:05	1
Thomas	Pam	11:05	H3
Walker	Juanita	11:05	H20
Waterman	Charles P.	8:30	H2
White	Jerry	11:05	10
Williams	Alma	8:30	6

Today's students need to learn *when* to use mathematics as much as they need to learn *how* to use it.

Everybody Counts

OCMC Eighth Annual Conference
Irvine High School, Irvine, CA
October 1, 1994

Name (Please Print)	School
New Member? Renewal? New Info?	District
Home Street Address	School Street Address
City State Zip	City State Zip
Home Phone	School Phone

Position: Teacher _____ Student _____ Paraprofessional _____ Administrator _____
Other (Please specify) _____

Level: Elementary _____ Junior High _____ Senior High _____ College _____
University _____ Other (Please specify) _____

I would like to be involved in the following:

A) Conference Planning
1) Committee
2) Speaker
3) Presider

B) Math Field Day (Grades 4-6)

C) Newsletter

D) Awards Committee

E) Grade Level Representative

F) Membership Committee

G) Other

Are you interested in being a Presider? _____ If so, for which grade level? K 1 2 3 4 5 6 7 8 9 10 11 12

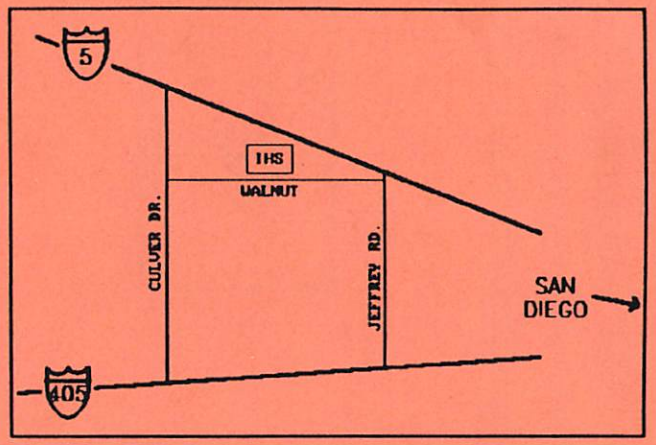
Conference Registration

Pre-Registration (Includes Membership)	$25	☐	**Mail to:** **Suzette Blankey** **6 Brookmont** **Irvine, CA 92714**
On-Site (Includes Membership)	$35	☐	
Speaker Registration	$ 0	☐	
Membership	$10	☐	
Committee Member Registration	$ 0	☐	
Membership	$10	☐	$ _____
CMC Membership (optional)	$20	☐	$ _____
(Registration includes lunch)	**Total**		$ _____

Pre-Registration Deadline - September 17, 1994 **Make checks payable to OCMC**

IRVINE HIGH SCHOOL

4321 Walnut Ave.
Irvine, CA 92714



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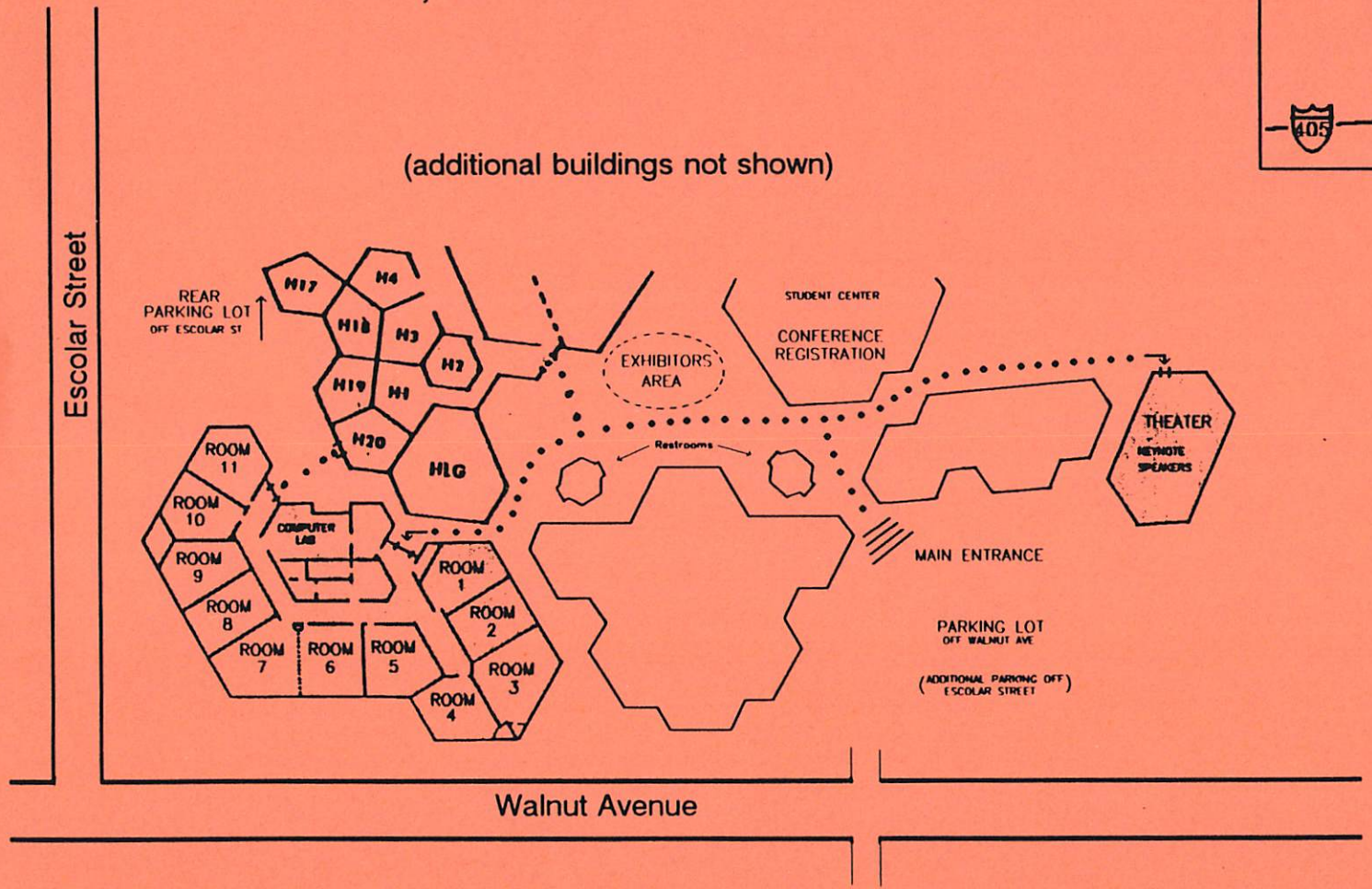


Orange County Mathematics Council

AN AFFILIATE OF THE CALIFORNIA MATHEMATICS COUNCIL - SOUTHERN SECTION

ORANGE COUNTY MATHEMATICS COUNCIL (OCMC)
Department of Mathematics
California State University, Fullerton
Fullerton, CA 92634

Challenging Students to Speak and Write Mathematically In Kindergarden, First and Second Grades

The Mathematics Framework for the California Public Schools tells us that an empowering mathematics program has all students frequently reflecting on their thinking, orally and in writing. There is an increased emphasis on communication in all strands. How do teachers provide opportunities for kindergarden, first and second graders to speak and write about their mathematical thinking?

Let's share ideas on :

Sources:

First Steps:

Motivating Writing:

Materials:

Writing:

Assessment:

Name_____ Date_____

INVESTIGATION 1

The Puddle Problem

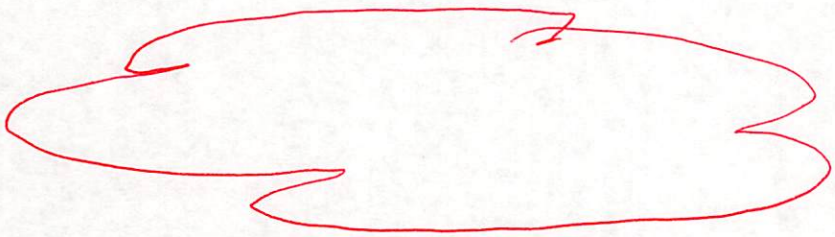
How would you measure a puddle?

Draw a picture of a puddle. Show and write all the ways you can think of to measure it.

Intro:
→ set up - measuring stuff - spoon - type measure . . .
① Draw puddle
② How to do it.

1 2 3 4
Self Assessment

How did you feel about this assignment?



- yard stick - depth, width length
- freezer - temperature - hot, cold, cool
- nose - smell → no smell, oily smell yukky smell
- cup - how many cupfuls
- tongue - how does it taste - not recommended because of "bugs" in water -
- how many beans - area
- how long does it take to evaporate

Kind - (what to pond)

- person on measurement
- word bank

Assessing the Work

In this assessment, we are interested in finding out what students know about measurement. What do they measure—length? depth? volume? What tools do they use—rulers? measuring cups? sticks and string? Some students choose one tool and describe its use in words and pictures; some suggest a collection of tools for measuring. What they report on is usually what they have internalized from their experiences so far with measurement.

Questions to ask yourself while scoring a response:

- **What different dimensions of the puddle does the student plan to measure?**
- **What measurement tools does the student use? Are the tools appropriate for the measuring task?**
- **How clearly does the student communicate a plan for measuring the puddle?**

Scoring Rubric

Low Response

Measurement methods proposed are unclear or unworkable. Explanation is missing or limited, and the response may be difficult to understand.

Medium Response

Measurement methods are fairly clearly presented; they tend to be the most obvious choices. Explanations are adequate, with limited details.

High Response

The measurements and tools are clearly presented and may include some original ideas. The response shows a good understanding of the problem. Explanations are clear, with some details.

Exceptional Response

The methods for measuring go beyond the most obvious to include strategies that show original thought for the student's age. The response reveals an ability to think through a complex problem. Explanations are clear and effective, and include relevant details.

Generalized Scoring Rubric

Responses in each category show some of the following characteristics:

Low Response
- Shows little grasp of the concepts.
- Fails to address significant aspects of the problem.
- Has major errors.
- Communicates poorly.
- Does not explain thinking.

Medium Response
- Shows some understanding of the concepts.
- Contains a complete response.
- Communicates unclearly or inappropriately.
- Explains thinking adequately, with little detail.

High Response
- Shows understanding of the concepts.
- Contains a complete response.
- Shows creativity.
- Communicates effectively.
- Explains thinking clearly.

Exceptional Response
- Contains all the characteristics of a high response.
- Goes beyond the requirements of the problem.
- Shows original thought.
- Gives strong supporting arguments.
- Explains thinking coherently and unambiguously.
- Shows exceptional mathematical thinking for the grade level.

literature:

"How big is a foot?"

"Jim & the Beanstock"

Sources ⇒ "Problem Pup"

"Brain Teasers" also ⇒ "Problem of the Day"

good book → how do you feel now

Ice cube

water cycles

Writing book:

five pages - limited.

Daily oral math

(1) prob -
(2) answer collected
(3) correct answer
why / explain

8997-3585 Carol Inglis re: Math Journals Feb. 9th

Writing In Math Journals

When children learn that their thinking is valued they feel more confident with journal writing. This can be a slow process that requires your persistence and patience. For most children, writing in mathematics will be a new experience. At the beginning of one particular school year, I remember a student who appeared to be actively engaged in the writing process. However, when I read his journal entry, I found he had written all the questions and two or three word responses. By the end of the school year, he was writing a full response to each question.

The Pre-Writing Stage

It is important to spend a lot of time during the pre-writing process to develop a child's mathematical language through real-life problem solving experiences.

The Role of a Teacher as Facilitator of Learning

As children use their own language to make discoveries, help them connect their ideas with appropriate mathematical language to strengthen their understanding of mathematical ideas. By the time students are asked to write in their math journals, they should be comfortable with the language used during the math exploration.

The Pre-Writing Stage

During the pre-writing stage, emphasis should be placed on:

- Real-life experiences
- Oral language
- Group work
- Problem solving
- Manipulatives
- Calculators
- Literature

The Teacher's Role

To establish your role as facilitator of learning, encourage children to:

- Ask questions
- Describe observations
- Generate predictions
- Make estimations
- Explain strategies
- Communicate discoveries
- Evaluate results

How to Create a Mathematically-Rich Learning Environment

The classroom should be rich in mathematical print. As students share their ideas, record their thoughts on the board using diagrams, pictures, graphs, charts and symbols. Children need to see that their ideas can be transferred into print. Demonstrate how to make a *word web* or *Venn diagram* to help students cluster their ideas during the pre-writing stage.

An Overview: Grade Level Lessons

Grade	Questions For Reflection	Math Exploration 1	Math Exploration 2	Questions For Reflection
K	**What I Already Know About Numbers** *One Yellow Lion*	**Shapes: Plane Figures** *A Fishy Shape Story*	**How Many Ways?** *Moon To Sun*	**What I Learned About Numbers** *One Watermelon Seed*
1	**What I Already Know About Numbers** *Ten Black Dots*	**Money** *Dollars and Cents for Harriett*	**How Many Feet?** *How Many Feet in the Bed?*	**What I Learned About Numbers** *Demi's Count the Animals 1-2-3*
2nd	**What I Already Know About Numbers** *10 for Dinner*	**Measurement: Length** *Jim & the Beanstalk*	**More Than, Less Than or Twice As Many?** *The Baby Blue Cat & the Whole Batch of Cookies*	**What I Learned About Numbers** *Two Ways to Count To Ten*
3rd	**What I Already Know About Mathematics**	**Geometric Solids** *If You Look Around You*	**Eight Dinner Elsie** *Six Dinner Sid*	**What I Learned About Mathematics**
4th	**What I Already Know About Mathematics**	**Multiplication** *Sea Squares*	**How Many Rabbits?** *The April Rabbits*	**What I Learned About Numbers**
5th	**What I Already Know About Mathematics**	**Fractions** *Eight Hands Round*	**Baker's Dozen** *The Baker's Dozen*	**What I Learned About Numbers**

How To Assess Mathematics Journals

Discussion questions and questions for reflection must be chosen carefully to elicit journal responses that help you assess students' mathematical understanding. For example, after students have worked in a problem solving situation, applying mathematical concepts to solve an open-ended problem, have them respond to questions that reveal how well they can think, solve and communicate their ideas:

- What was the problem?
- How did you solve the problem?
- What strategies did you use?
- Is there another way you could have solved the problem?
- What mathematics did you learn?
- How did you work cooperatively with other group members?
- How did you feel about the problem? Why?

Before you can assess each student's journal entry, it is important to know what kind of responses you are looking for. You need to think about what elements would make a good answer. If a student is asked to respond to the question, "What is multiplication?", a thorough response should include the idea that multiplication means counting equal groups. It doesn't matter whether the student uses words, pictures, charts, or diagrams in the answer, but this idea must be communicated effectively for a thorough response.

Assessment of journals can be formal or informal.

An informal assessment can be:

- A written response or brief comment from the teacher, which could include praise for the elements of the entry which closely match the standards she has set up, as well as, suggestions for improvement.
- A self-assessment by the student, after the student has compared his or her journal with a partner's or members of a small group, or after a few journals have been shared with the entire class.

More formal means could include:

- Sorting papers into high, medium and low responses
- Attaching a 4 x 6 card, folded in half. List *evidence of strength* on one side and *areas for improvement* on the other side.
- Developing a checklist that lists standards for a high response. Use it to grade particular entries (example below) and give the entry a 3 (total) 2 (partial) or 1 (minimal) for each student.

Checklist	3	2	1
Demonstrates an in-depth understanding of concepts			
Demonstrates an in-depth understanding of content			
All questions are answered completely			
Mathematical ideas are communicated effectively and clearly			

In this book, a short narrative is used to assess each sample journal entry. This is another, more informal way, to evaluate mathematical understanding.

Publications

- *Problem of the Day* Scott, Foresman and Company
- *Problem Play* Stephen Currie Dale Seymour Publications
- *Puddle Questions: Assessing Mathematical Thinking* Joan Westley Creative Publications
- *Math Journals: Tools for Authentic Assessment* Vicki Newman Teaching Resource Center Publication
- *Math Talk* The Mathematical Association (U.K.) Heineman

K

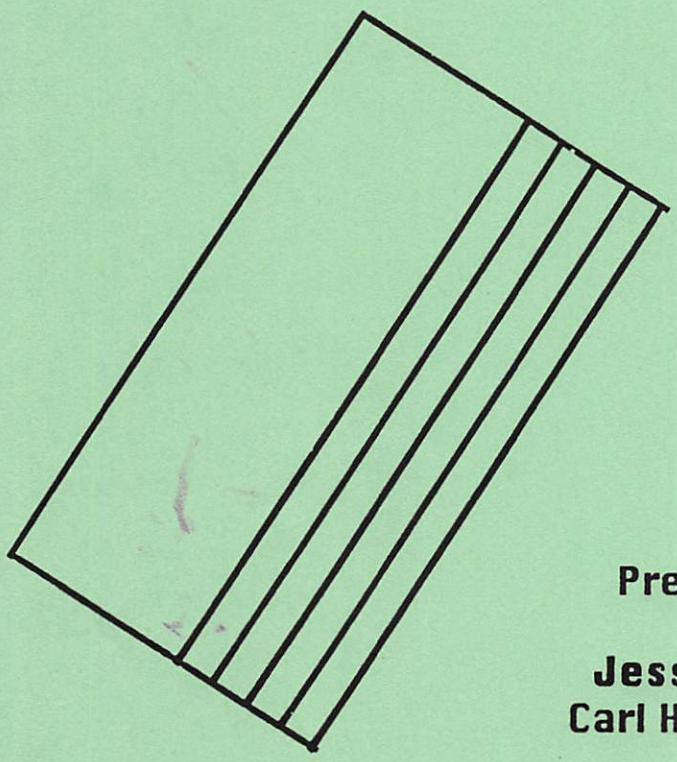
Lucy Cook, "Starters & Stumpers" gr 4-6 - 1020

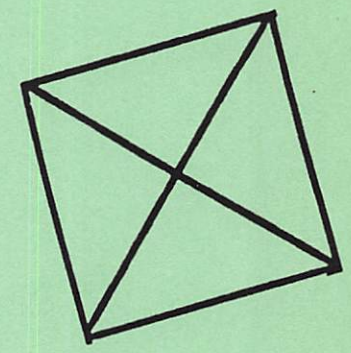
"Do Talk it Over"

Bobby

Marilyn Burns "Have you read any good math lately"

A Different Approach to Geometry





Presented by:

Jessica Banda
Carl Harvey School

and

Linda McGaugh
Carl Harvey School

Santa Ana Unified School District

EXPLORATIONS

IF I HEAR IT,
I FORGET

IF I SEE IT,
I REMEMBER

IF I DO IT,
I UNDERSTAND

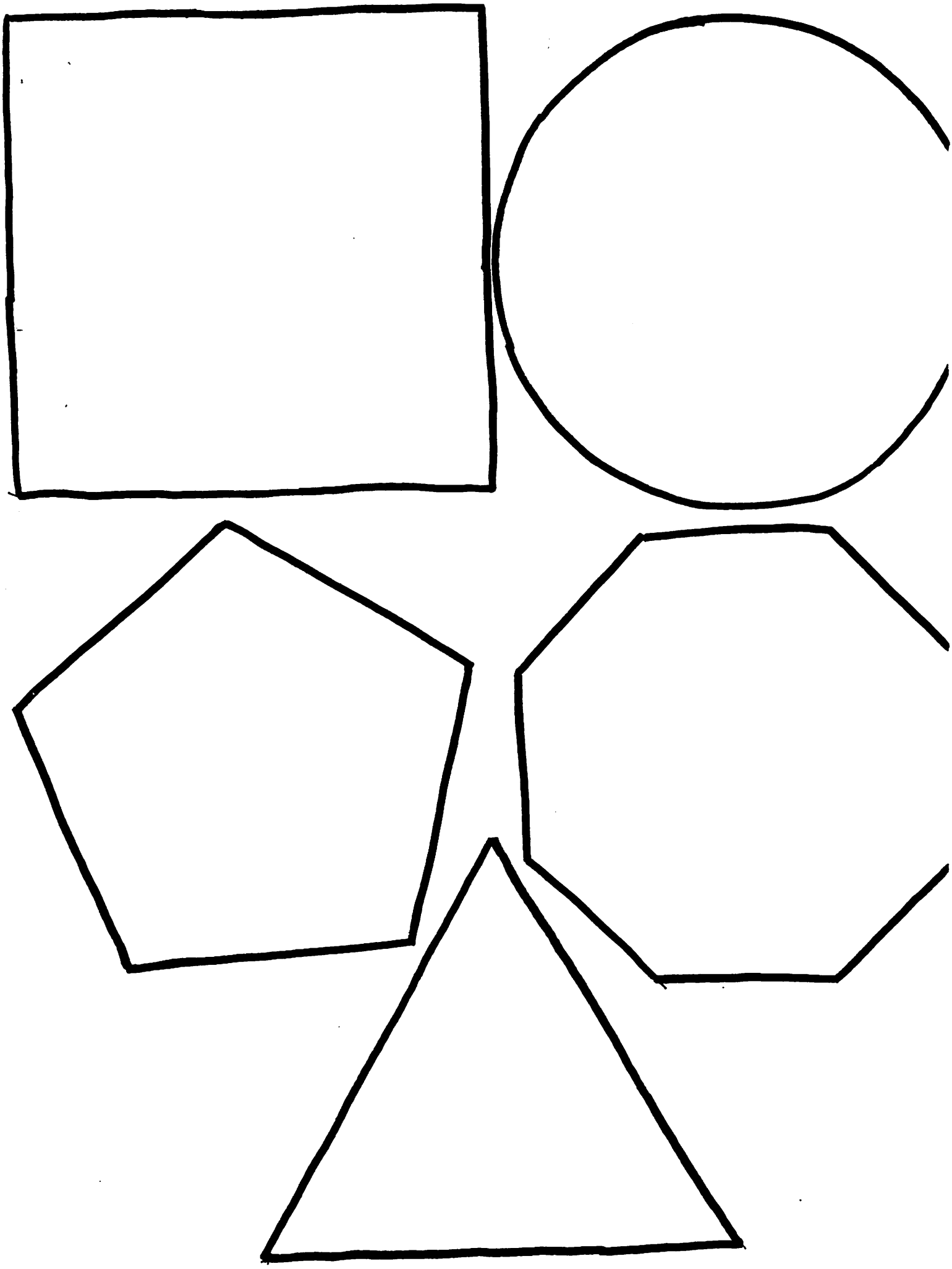
IF I SAY IT,
I INTERNALIZE.

Addison-Wesley Mathematics

Spanish Vocabulary: Geometry

1. point - punto
2. line - línea
    a. intersecting - líneas que se cruzan
    b. parallel - paralelo, -a
    c. perpendicular - perpendicular
    d. segment - segmento lineal
    e. ray - rayo
3. plane - plano
4. Collinear points - puntos colinear
5. Non-collinear points - puntos no colineares
6. Coplanar - coplanario
7. Space - espacio
8. Angles - ángulo
    a. acute - ángulo agudo
    b. obtuse - ángulo obtuso
    c. right - ángulo recto
9. Protractor - transportador
10. Triangles - tríangulo
    a. right - tríangulo recto
    b. acute - tríangulo agudo
    c. scalene - tríangulo escaleno
    e. isosceles - tríangulo isósceles
    f. equilateral - tríangulo equilátero
11. Quadrilaterals - cuadrilateral
    a. trapezoid - trapezoide
    b. parallelogram - paralelogramo
    c. rectangle - rectángulo
    d. rhombus - rombo
    e. square - cuadrado
12. Other Polygons - polígono
    a. pentagon - pentágono
    b. hexagon - hexágono
    c. octagon - octágono
    d. decagon - decágono

LAMP, November 1993



Book can be made

The Shapes

Circle, circle what can you be ?
Turn the page and you will see.

Triangle, triangle what can you be?
Turn the page and you will see.

Square, square what can you be?
Turn the page and you will see.

Rectangle, rectangle what can you be?
Turn the page and you will see.

Las Formas

Círculo, círculo ¿qué puedes ser?
Voltea la página y vas a ver.

Tríangulo, tríangulo ¿qué puedes ser?
Voltea la página y vas a ver.

Cuadrado, cuadrado ¿qué puedes ser?
Voltea la página y vas a ver.

Rectángulo, rectángulo ¿qué puedes ser?
Voltea la página y vas ver.

Teacher

Geometry
Open- Ended
Grade 4

MY VALUABLE CREATURE

Vocabulary
Circle
Square
Rectangle
Oval
Triangle
Value

Suggested Materials
Scissors
Glue
Construction Paper

Problem

Use the geometric shapes on the next page to design a creature that is worth at least $35.00. Cut and paste the shapes carefully to make your creature. Use crayons or markers to add details. Use at least 1 of each different shape. Explain your answer. Tell why you designed your creature as you did, name the shapes and tell what they are used for. Calculate the creature's value.

Circles = $5.00
Ovals = $8.00
Squares = $6.00
Triangles = $9.00
Rectangles = $7.00

Possible Solutions

Students are limited only by their imaginations.

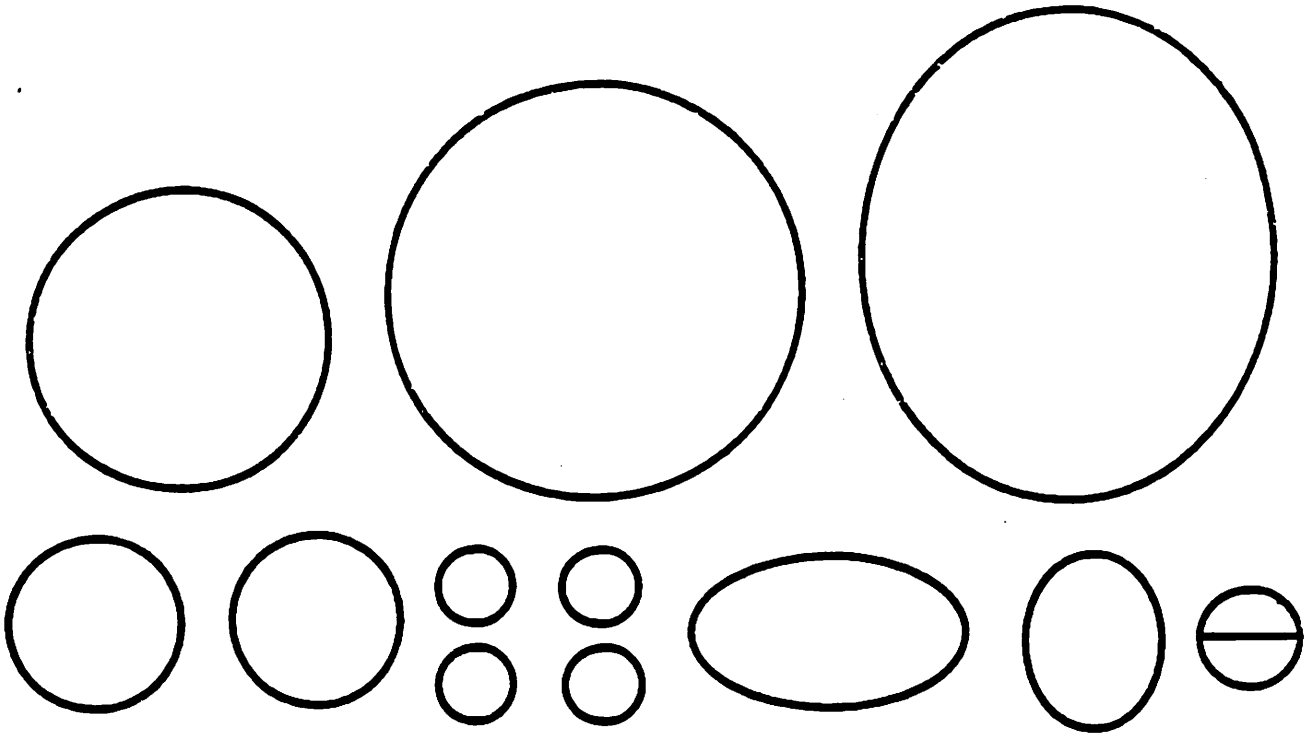
Draw
Describe & tell story

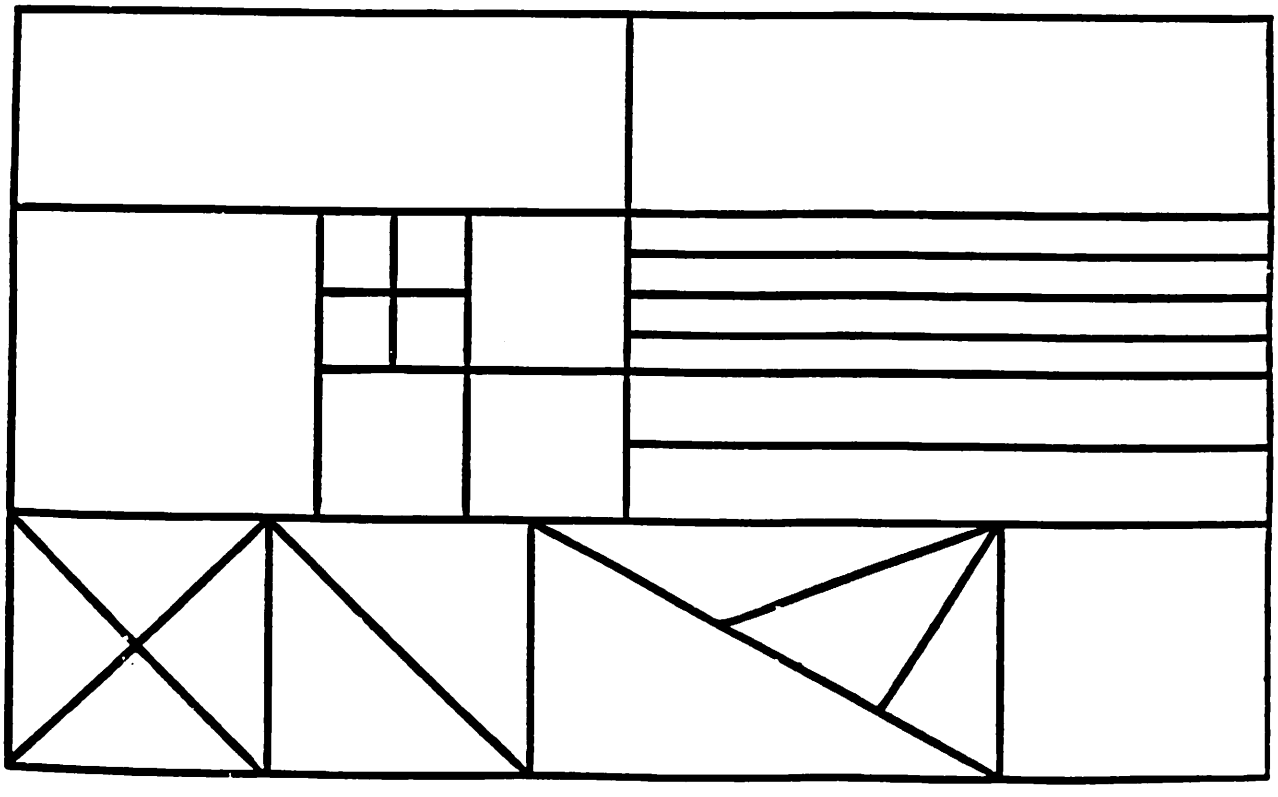
Variations

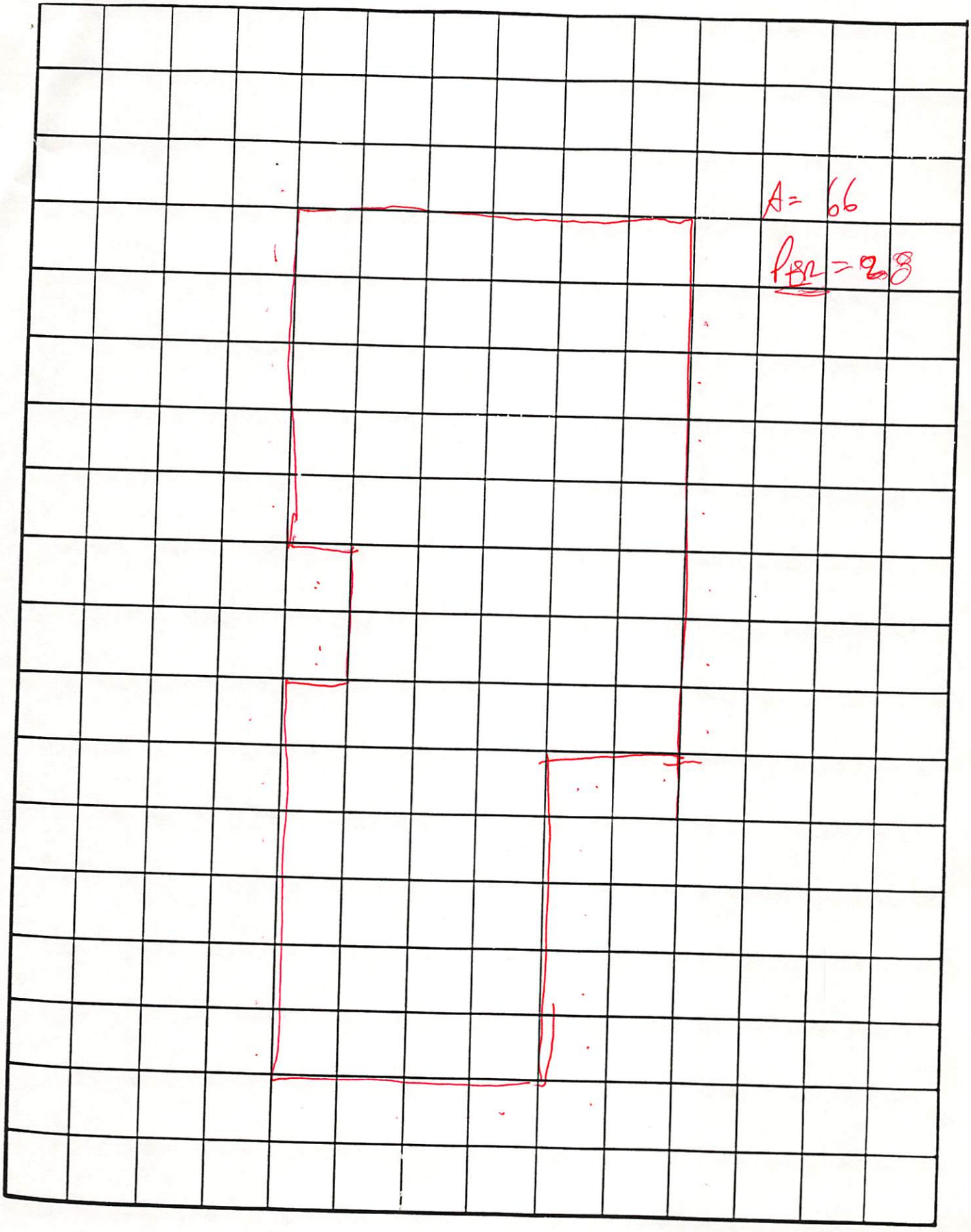
Write a story about your creature.

Developed by Pamela Manke

Geometric Shape Patterns






A= 66
P= 28

A DIFFERENT ANGLE

STRAND:
- Geometry

OBJECTIVES:
- Identify and classify angles.

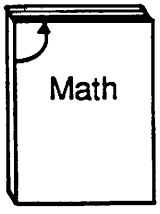
MATERIALS:
- Letter List, Angle Classification Chart
- Pencils

ORGANIZATION:
- Students work in Cooperative Learning teams or in pairs.
- Two days, 45 minutes each day.

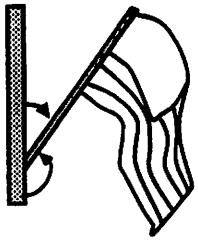
PROCEDURE:

1. Discuss the concept of an angle by showing examples of angles in the room. Examples include:

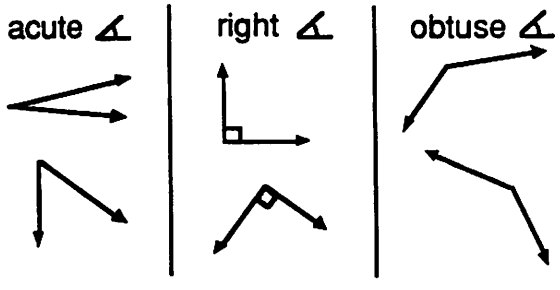
   a. Where edges of their books meet (right angle)



   b. Where the flag holder meets the wall (acute angle above, obtuse below).

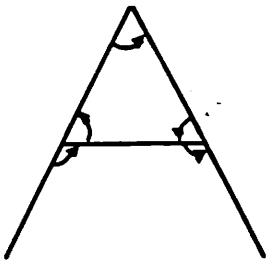


2. Draw examples of different angles on the overhead or on the chalkboard.



(Note, we show the angle is a right angle by drawing a little square at the vertex, using part of the angle as two sides of the square.)

3. Look at the angles in the letter A. Help students find all 5 angles (3 acute, two obtuse). Students can trace over each angle on the chalkboard in a different color.

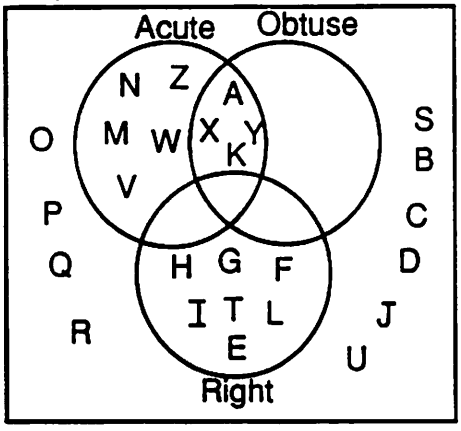


4. Note that since it takes two "straight lines" meeting to form an angle, the letters B, C, D have no angles.

5. Motivate the students to explore other letters and let them come up with the idea of classifying all letters of the English alphabet.

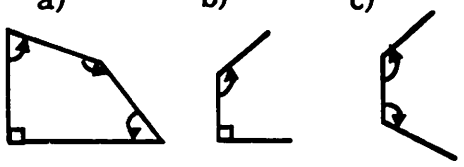
6. Give students the Letter List and Angle Classification Chart to complete. Students work cooperatively in pairs or groups of 3 or 4.

7. Draw a large Venn diagram on butcher paper, cut out one set of letters from the Letter List and have students take turns taping the letters to the appropriate region on the diagram.



8. Extension: Have students invent shapes that have : (a) all three types of angles, (b) obtuse and right angles; (c) only an obtuse angle (or only obtuse angles) and have them tape these shapes onto the Venn diagram

Examples: a) b) c)



A DIFFERENT ANGLE
Teacher Answer Sheet

Letter	# of Angles	# of Acute Angle	# of Obtuse Angles	# of Right Angles
A	5	3	2	0
B	0	0	0	0
C	0	0	0	0
D	0	0	0	0
E	4	0	0	4
F	3	0	0	3
G	1	0	0	1
H	4	0	0	4
I	4	0	0	4
J	0	0	0	0
K	4	2	2	0
L	1	0	0	1
M	3	3	0	0
N	2	2	0	0
O	0	0	0	0
P	0	0	0	0
Q	0	0	0	0
R	0	0	0	0
S	0	0	0	0
T	2	0	0	2
U	0	0	0	0
V	1	1	0	0
W	3	3	0	0
X	4	2	2	0
Y	3	1	2	0
Z	2	2	0	0

A DIFFERENT ANGLE
Letter List

A B C D E

F G H I J

K L M N O

P Q R S T

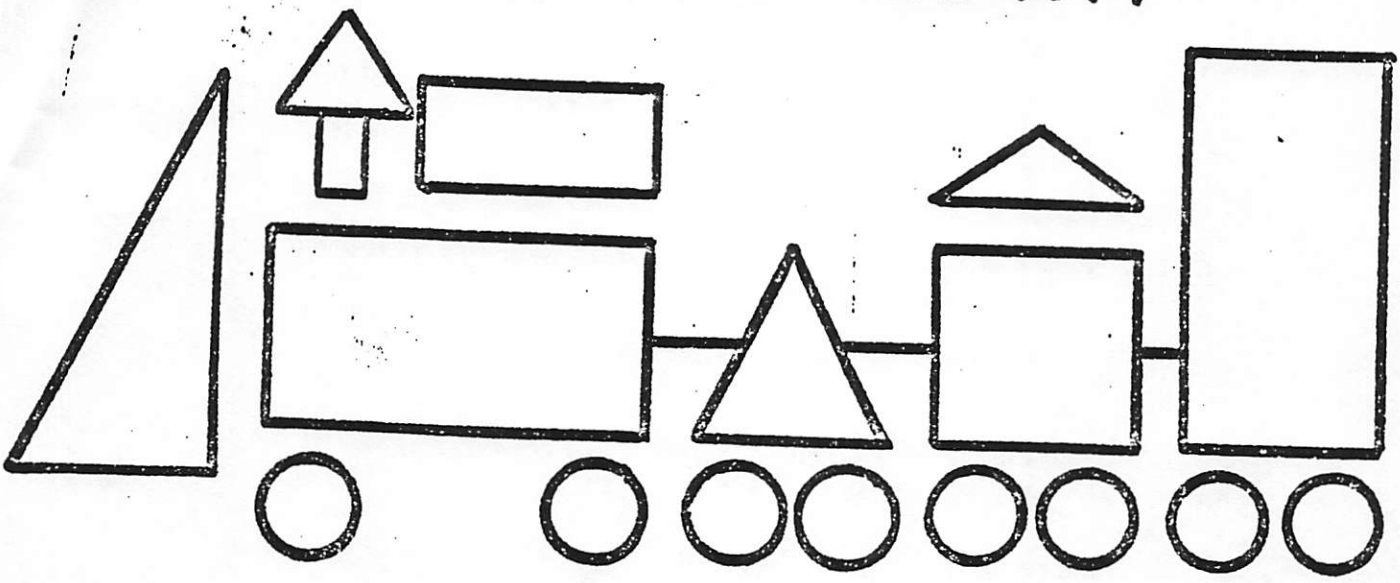
U V W X Y

Z

A DIFFERENT ANGLE
Angle Classification Chart

Letter	# of Angles	# of Acute Angle	# of Obtuse Angles	# of Right Angles
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				
K				
L				
M				
N				
O				
P				
Q				
R				
S				
T				
U				
V				
W				
X				
Y				
Z				

GEOMETRIC TRAIN



MATERIALS: FELT, CONSTRUCTION PAPER (IN YELLOW, RED, BLUE AND ORANGE), GLUE, MARKING PEN, TAGBOARD (FOR CHART).

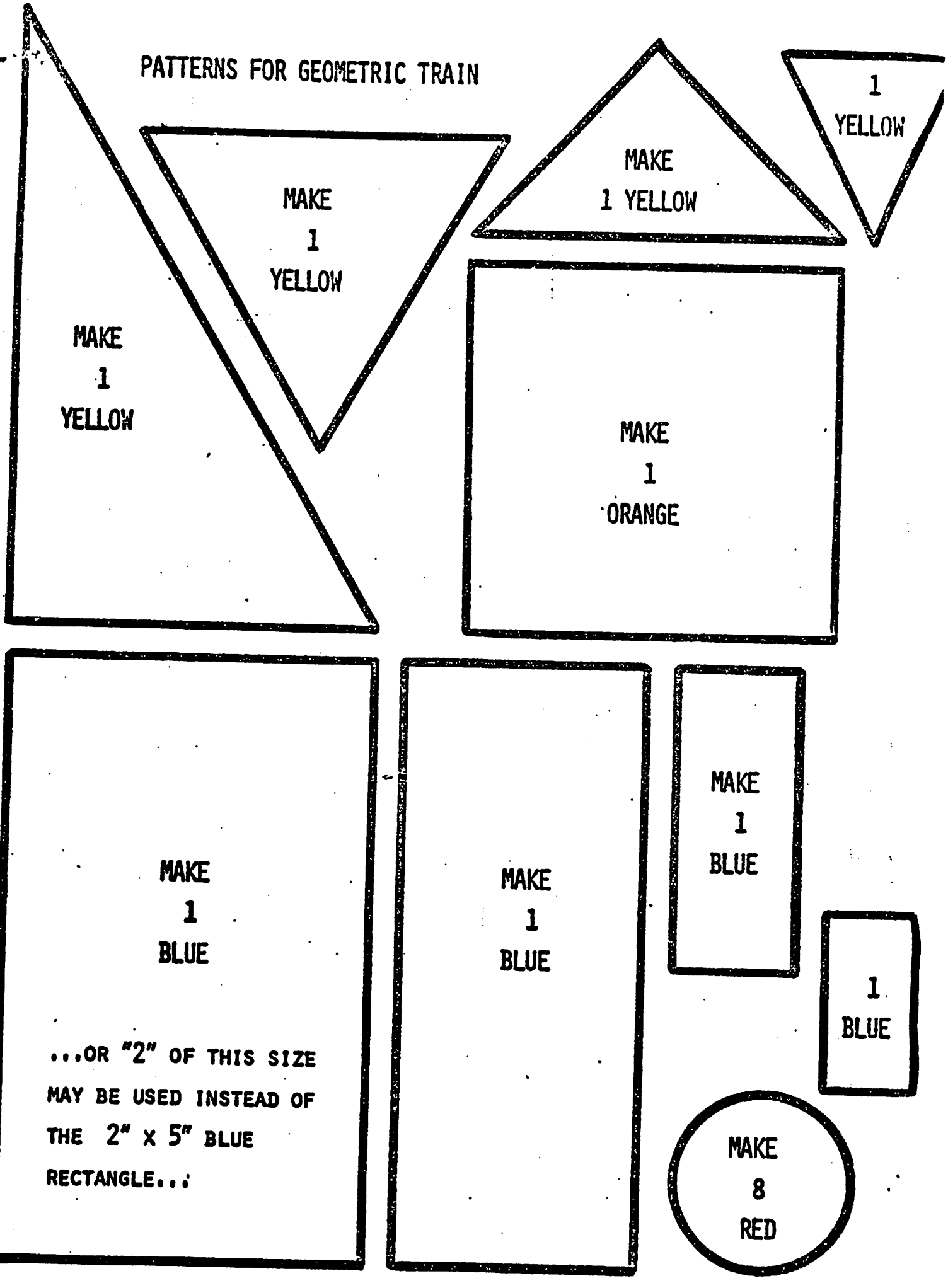
CONSTRUCT: USE THE PATTERNS AND RECOMMENDED COLORS...CUT ONE SET IN FELT...CUT ANOTHER IN CONSTRUCTION PAPER MAKE A CHART ON THE TAGBOARD WITH THE CONSTRUCTION PAPER SET. THE FELT SET MAY BE PUT INTO A PLASTIC BAG, TO BE USED ON A FLANNEL BOARD.

ADAPTATIONS:

- ...LOCATE AND IDENTIFY SHAPES
- ...CONSTRUCT THE TRAIN AS THE TEACHER INSTRUCTS
- ...COUNT NUMBER OF SHAPES THAT ARE THE SAME
- ...GROUP THE SHAPES INTO SETS
- ...FIND SHAPES THAT ARE EXACTLY THE SAME
- ...RECORD NUMBER SENTENCES

USE FOR COUNTING, ADDING, SUBTRACTING, LARGE AND SMALL, SAME AND DIFFERENT, GREATER THAN...LESS THAN

PATTERNS FOR GEOMETRIC TRAIN



"Teaching Math through Art Activities"
Grades 6-10 workshop

O.C.M.C.
The Orange County Math Council
8th Annual Conference

October 1, 1994
Irvine High School

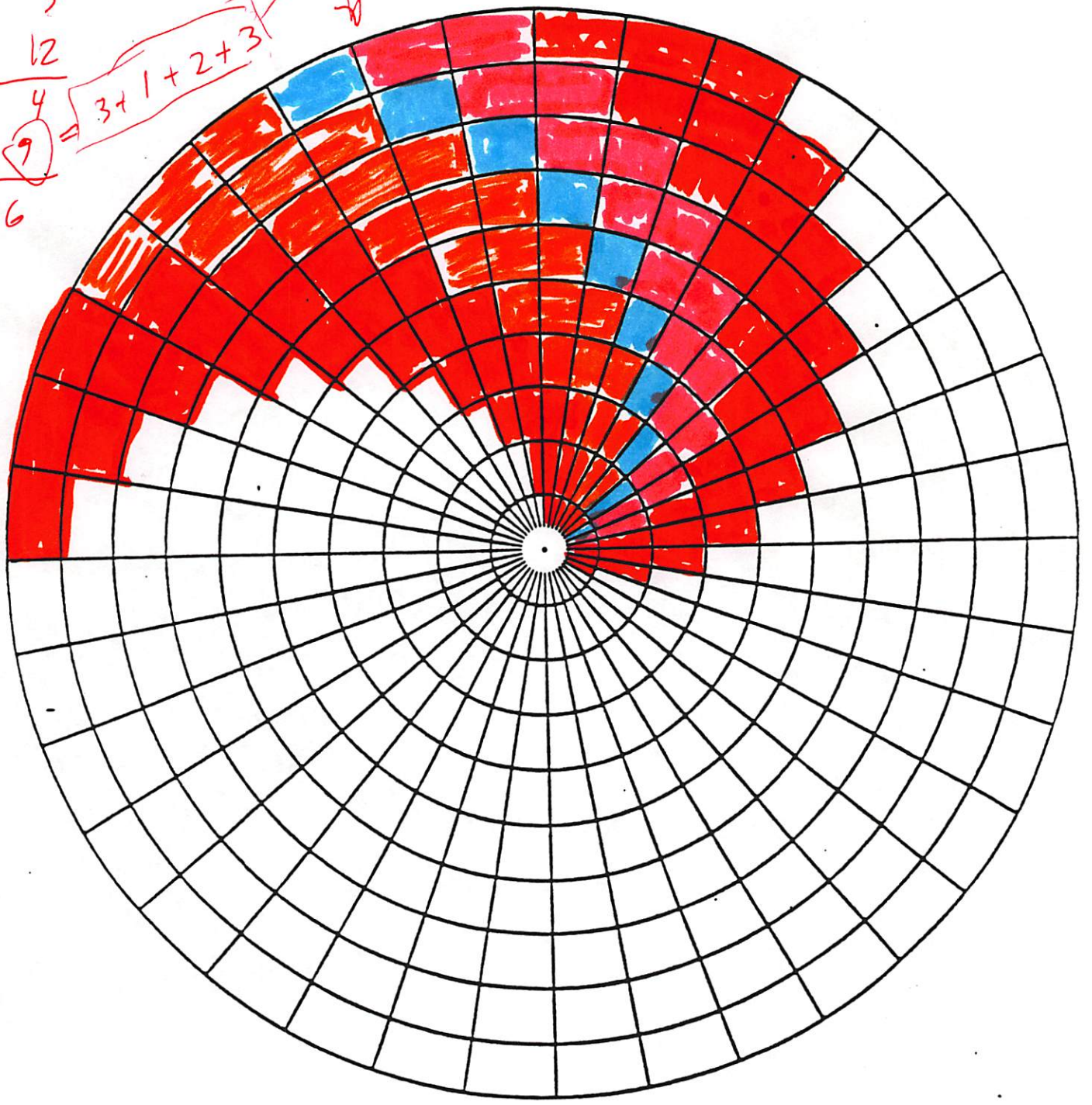
KAY McFALL
Johnson Middle School
Westminster School District

Factor Circle

36 rectangles

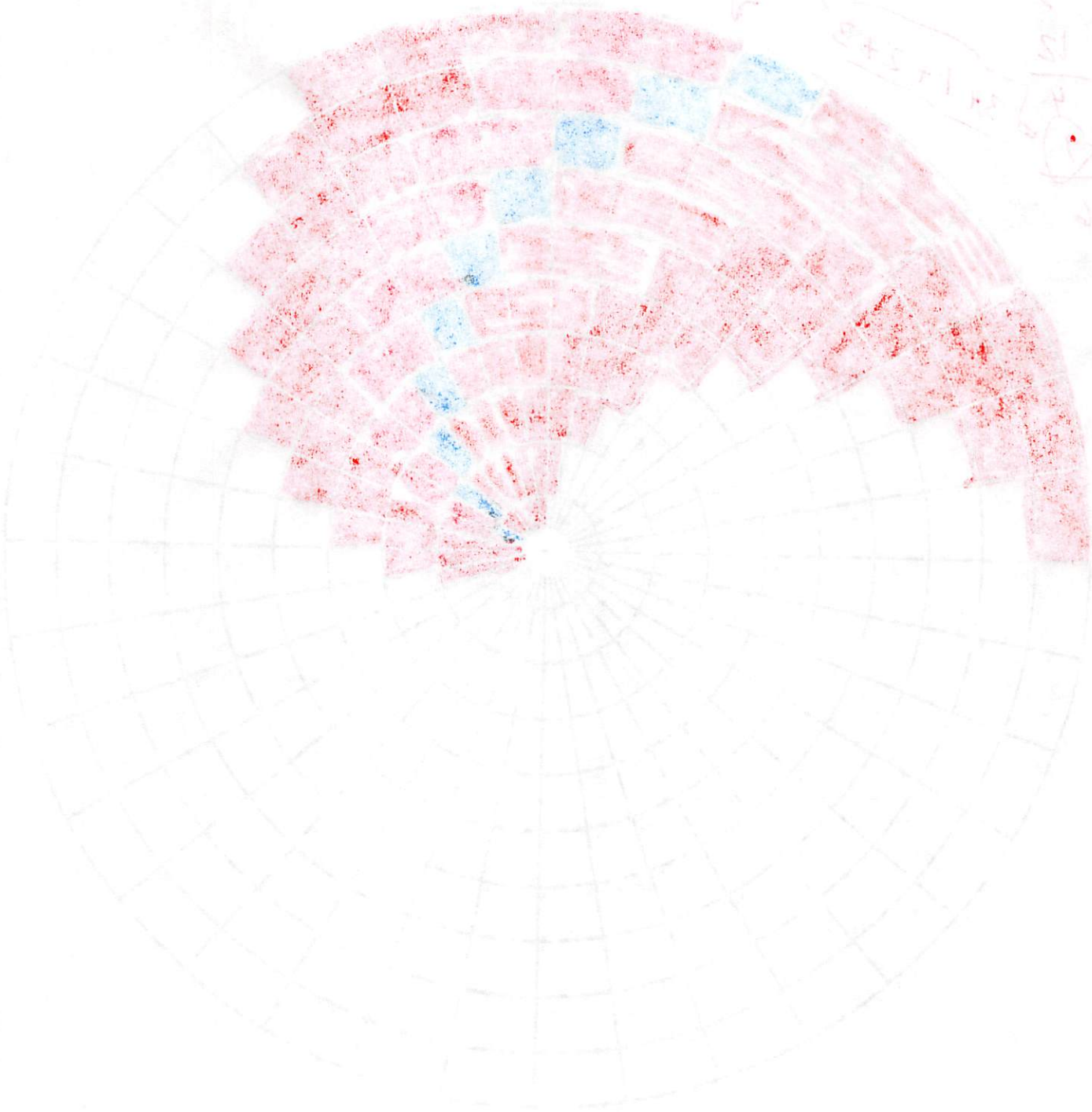
1
36
2
18
3
12
4
9
6

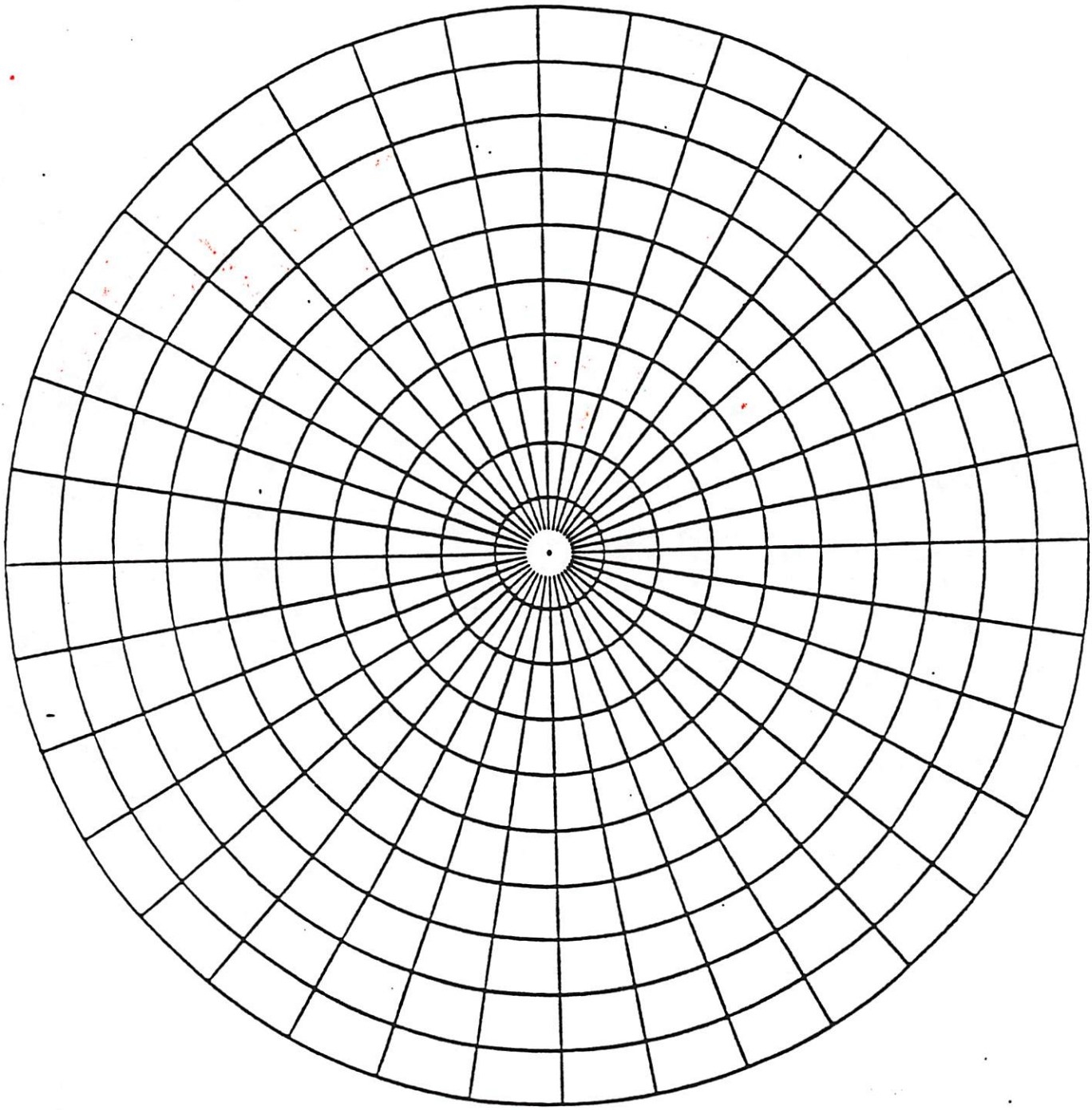
= 3+1+2+3



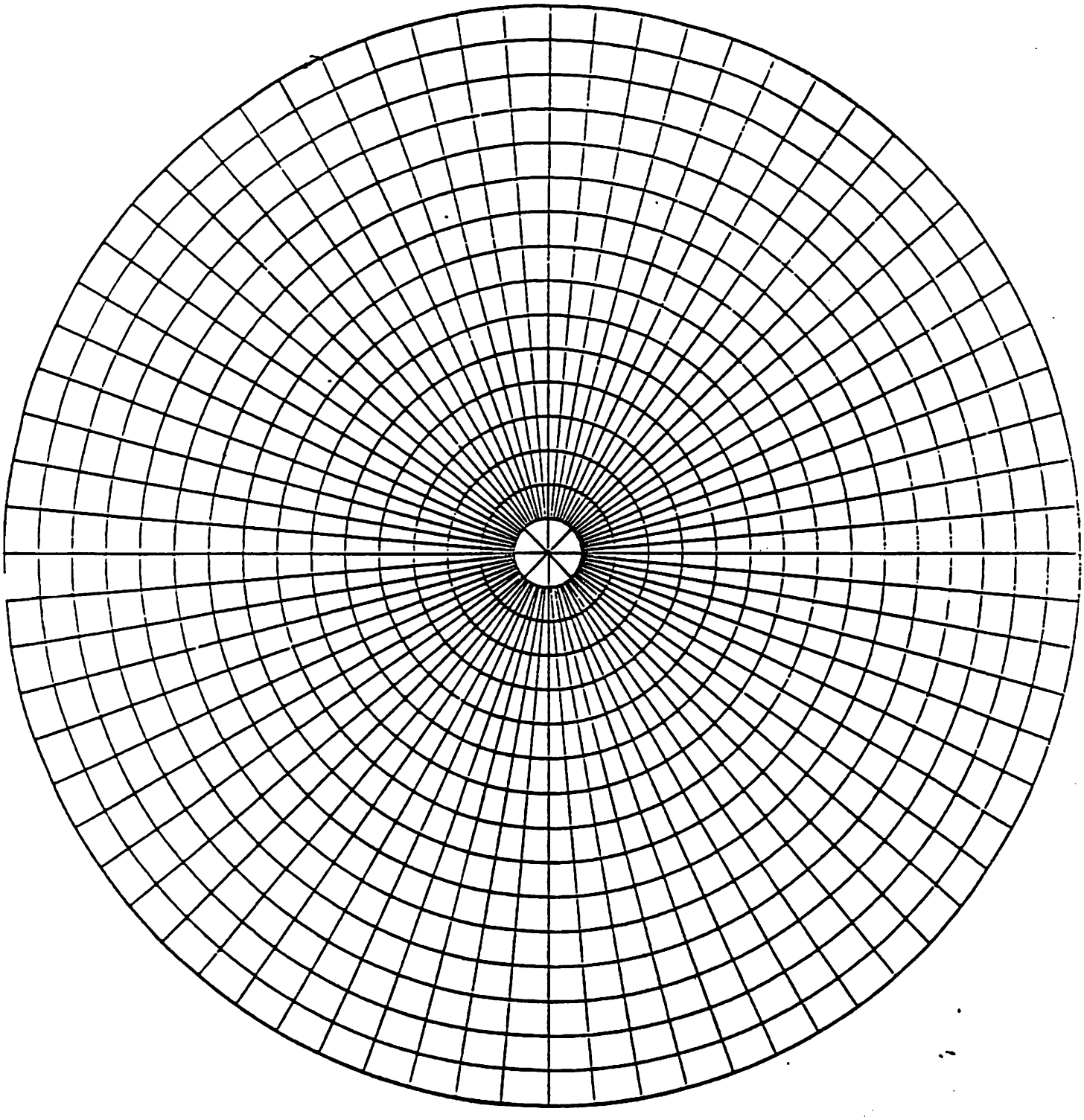
Algebra → Quadrants

Line designs = creative publication

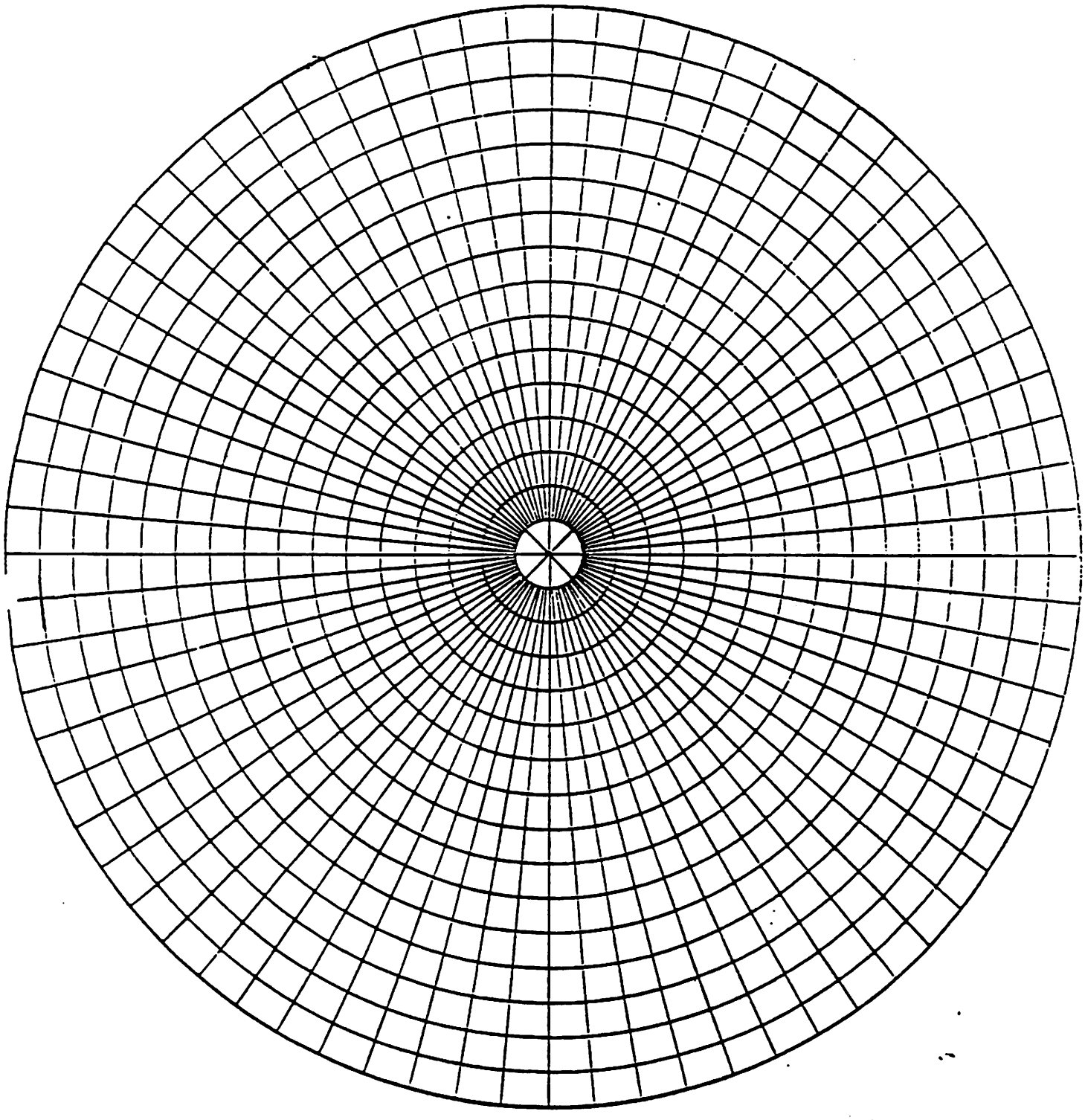




28 Polar Coordinates Grid/One-fourth inch units; 5 degree units

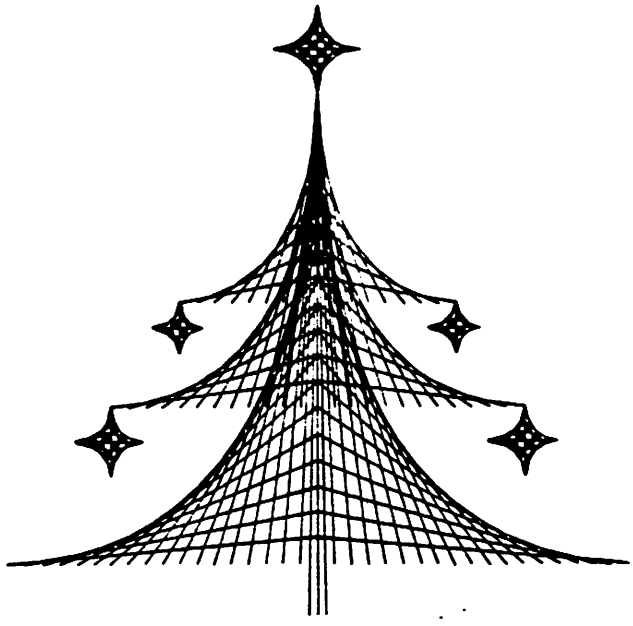


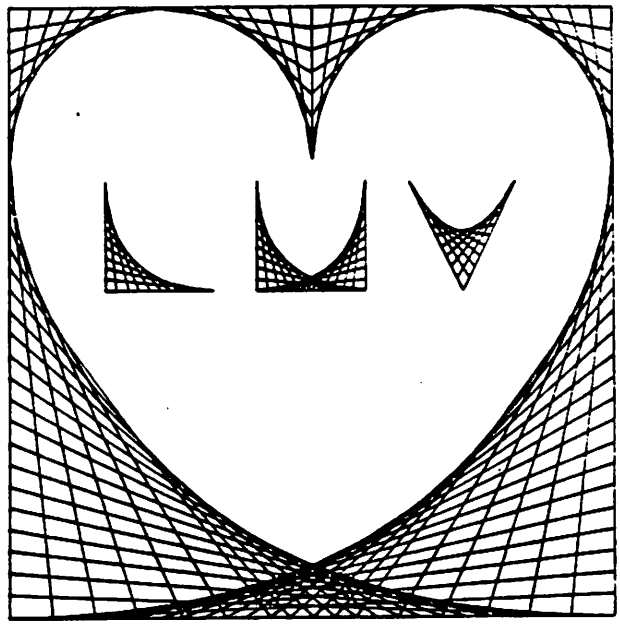
28 Polar Coordinates Grid/One-fourth inch units; 5 degree units

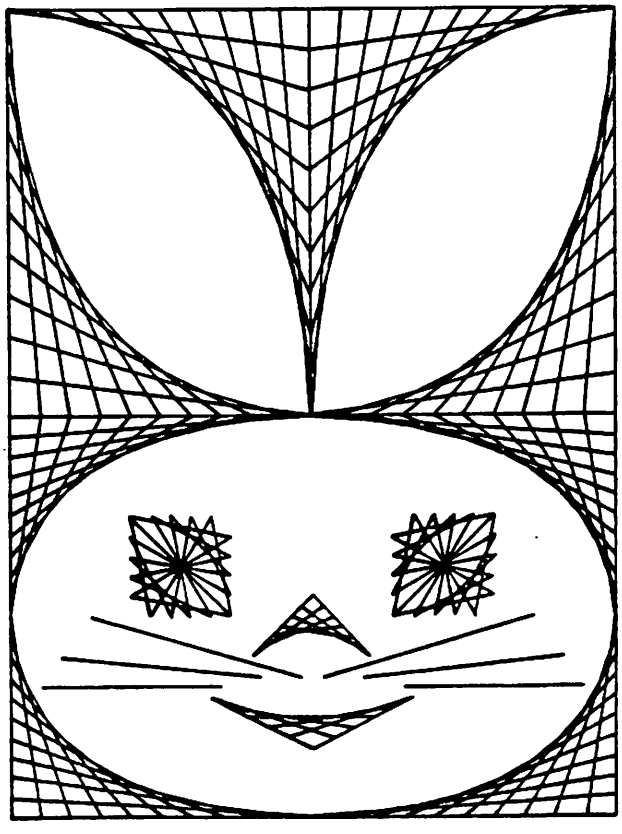


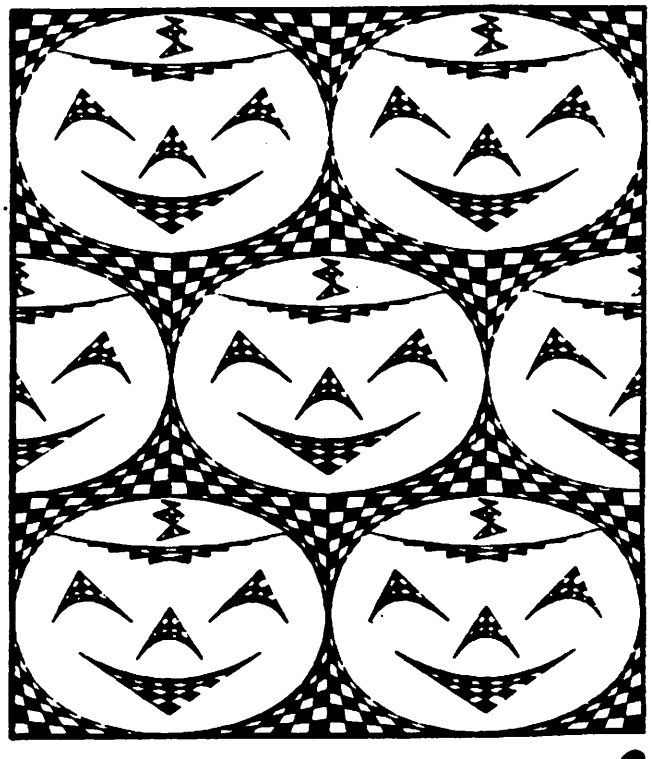
curve. stitching

HOLIDAYS

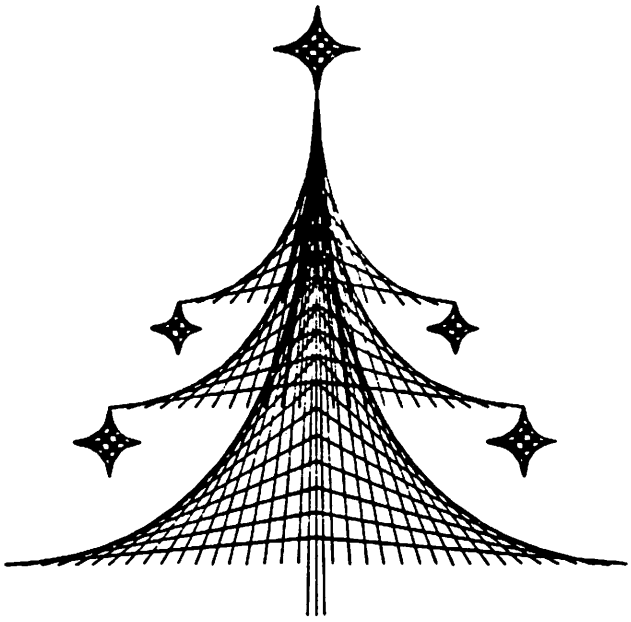


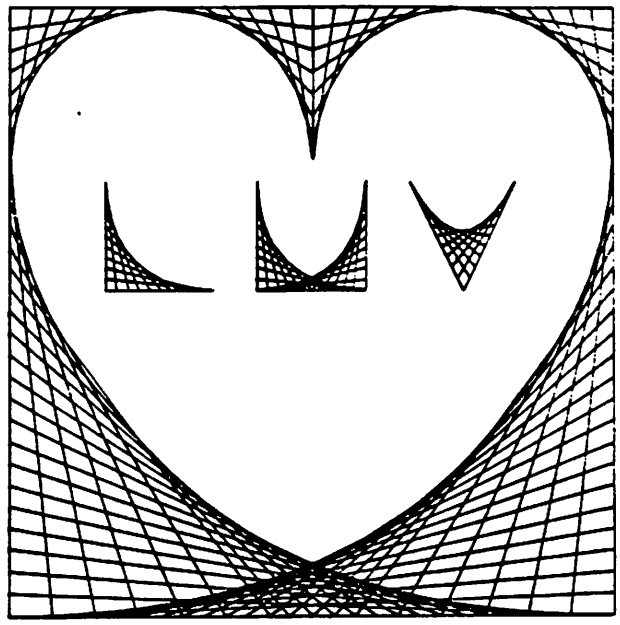


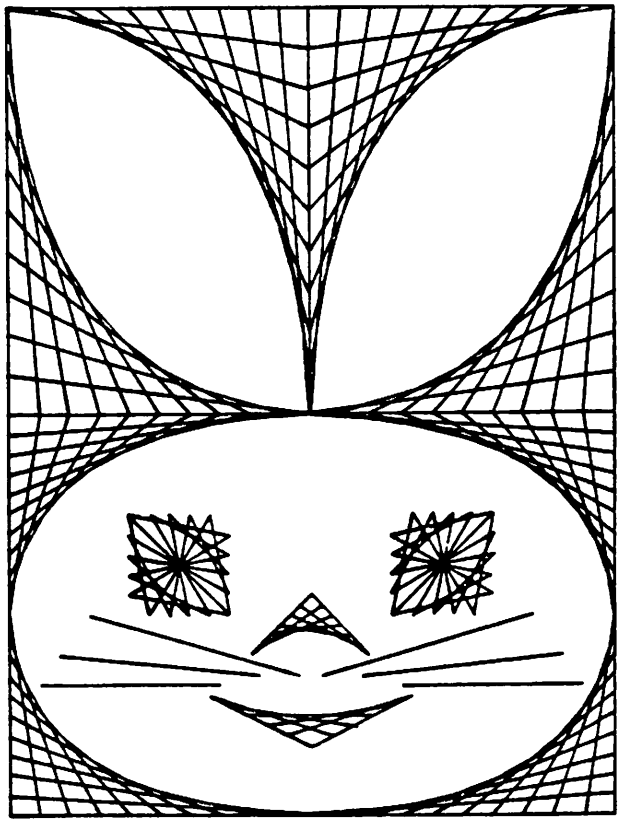


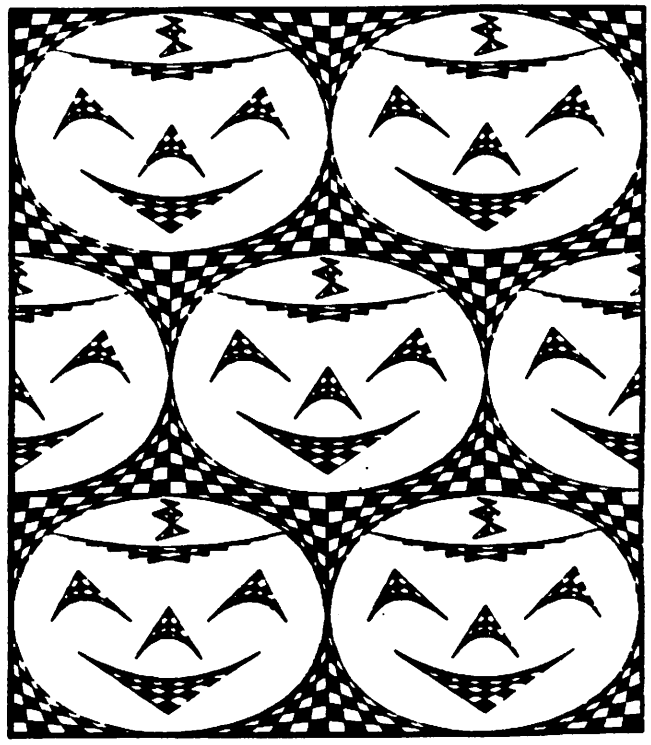


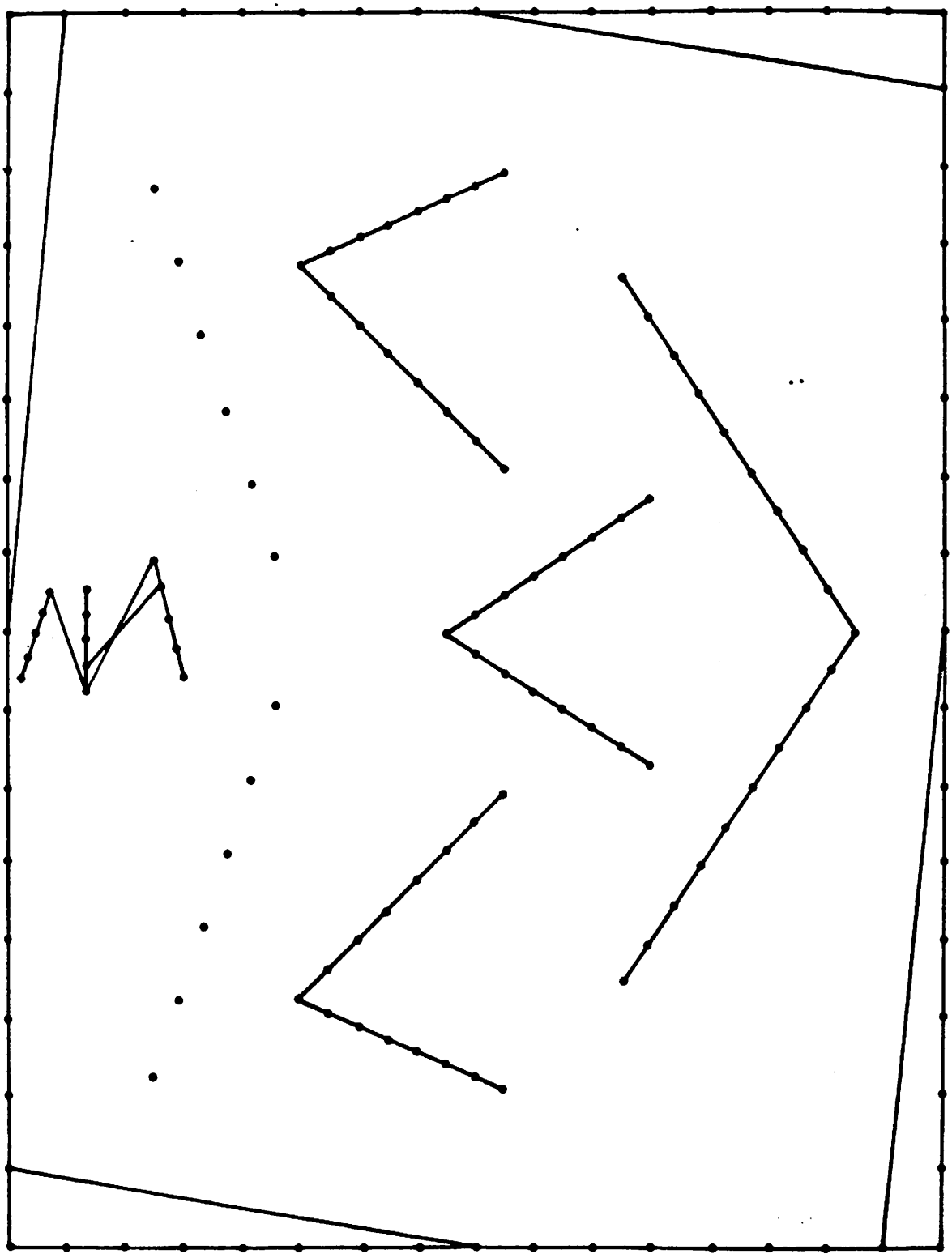
HOLIDAYS











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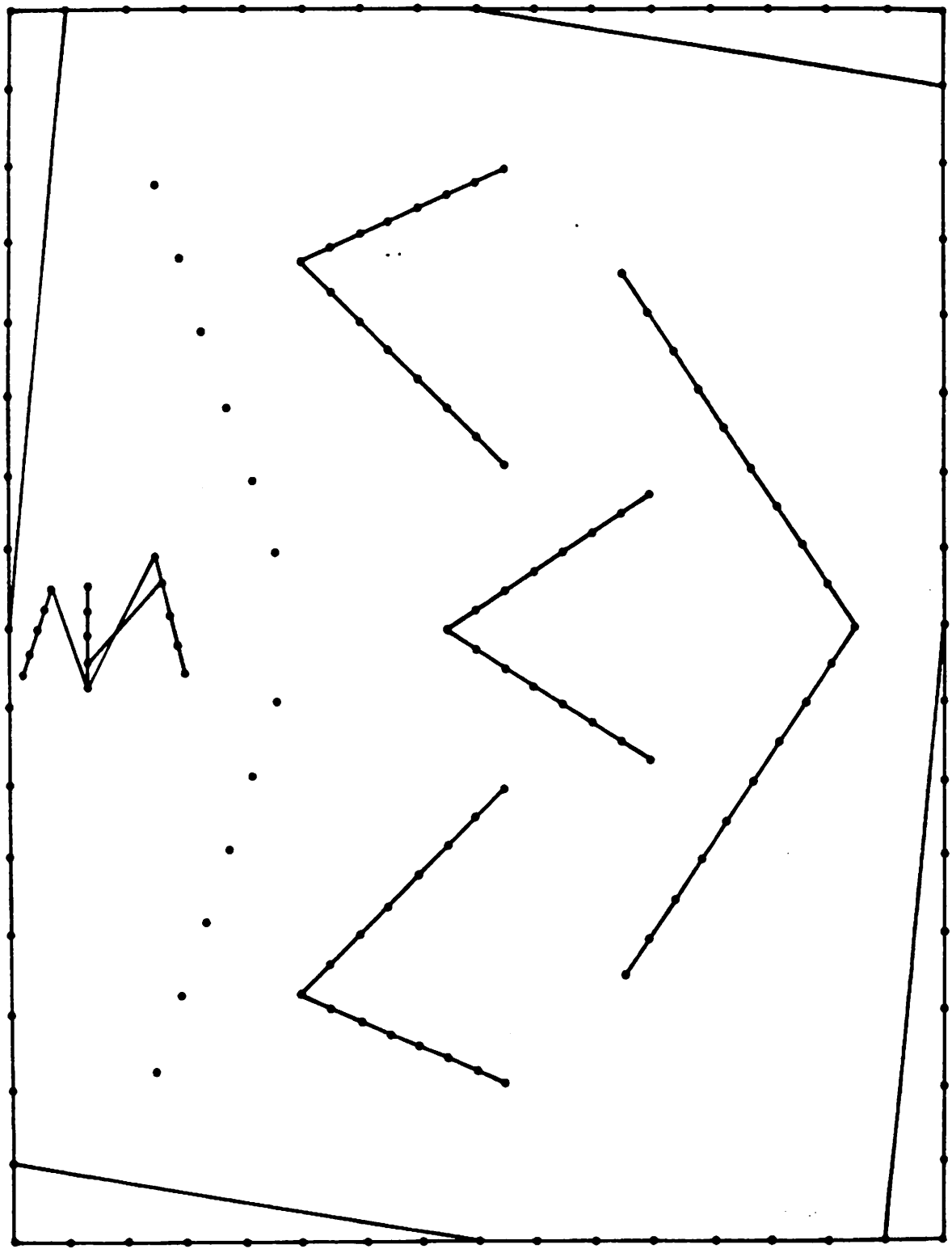

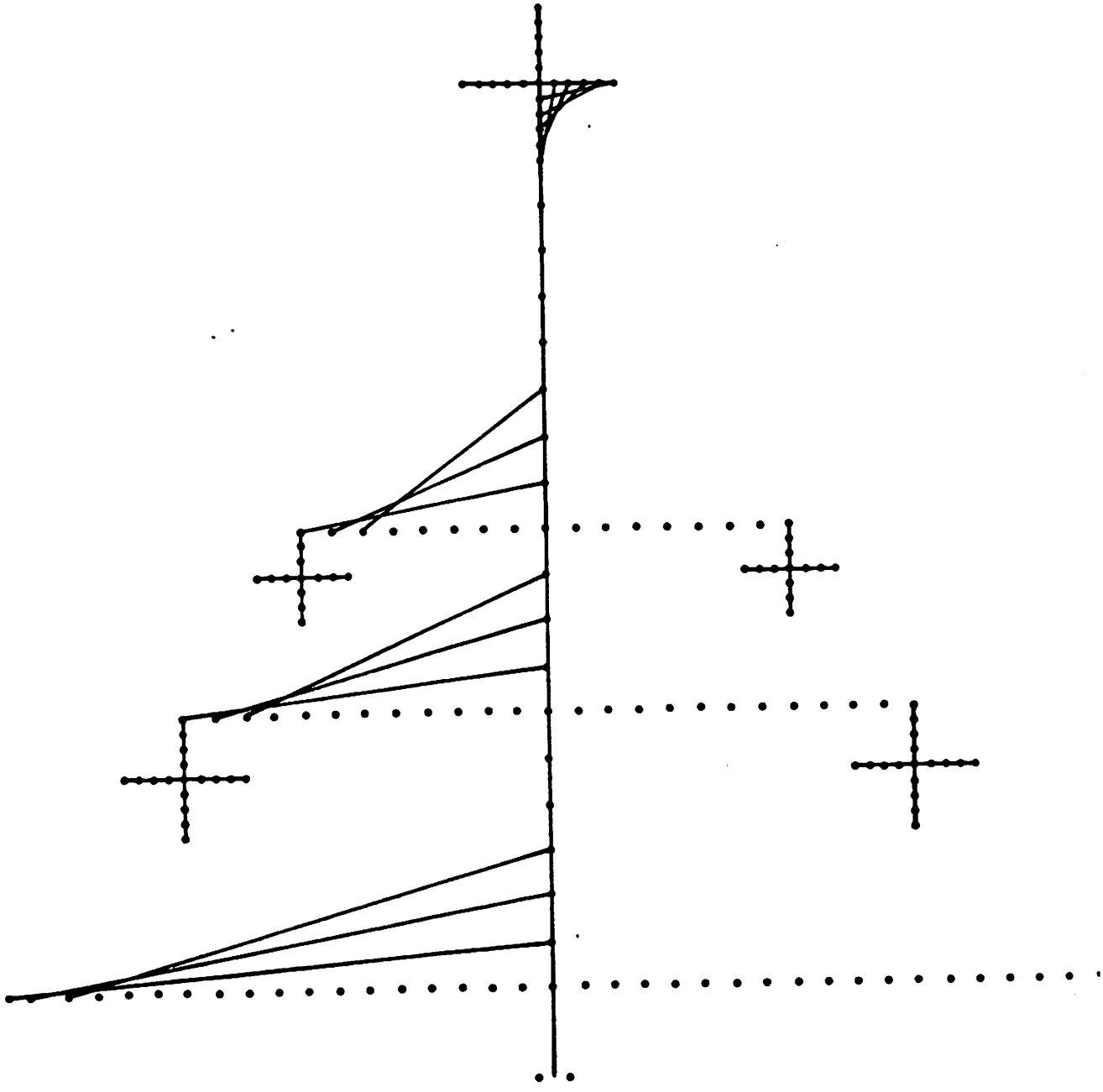

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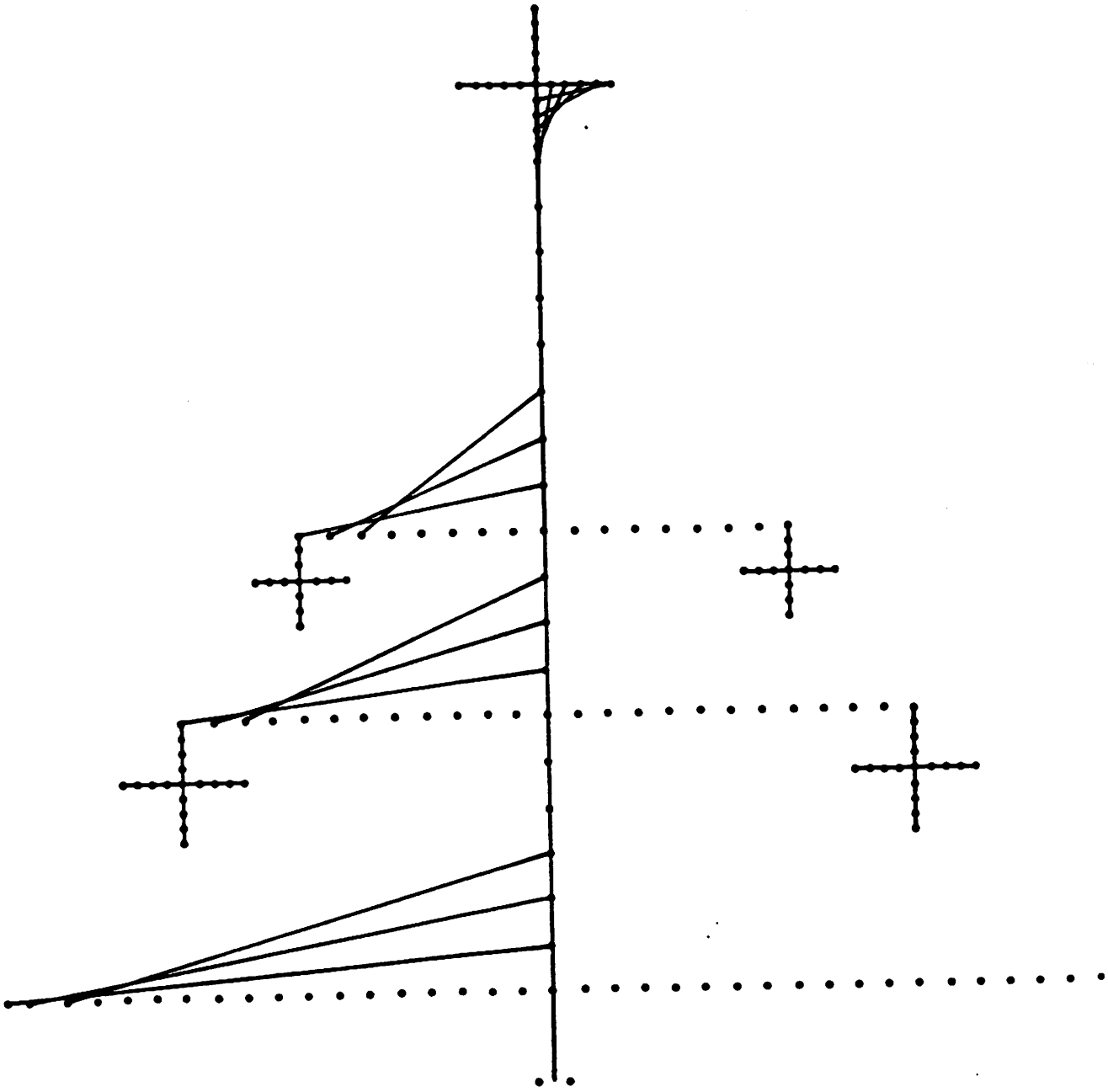

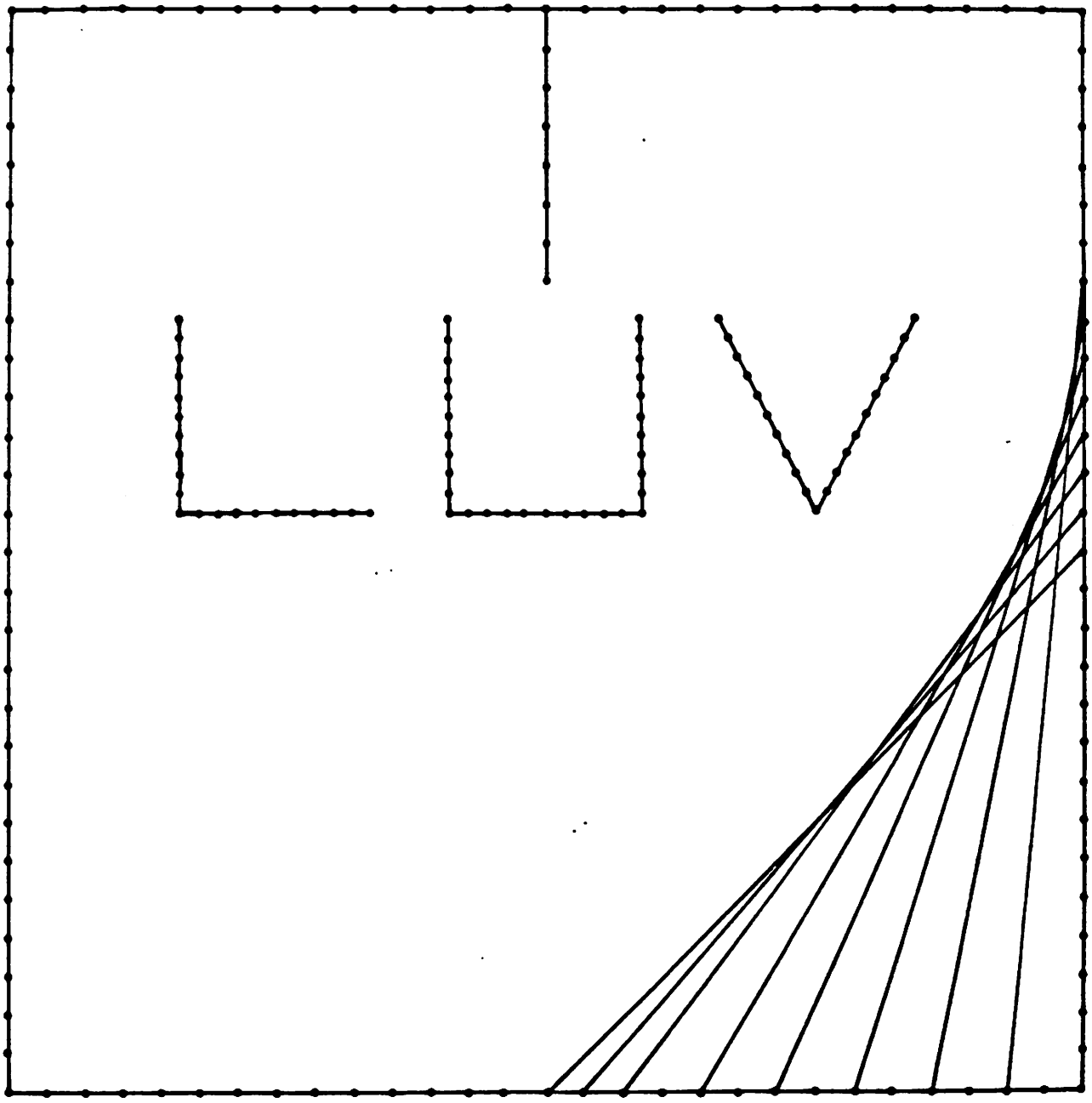

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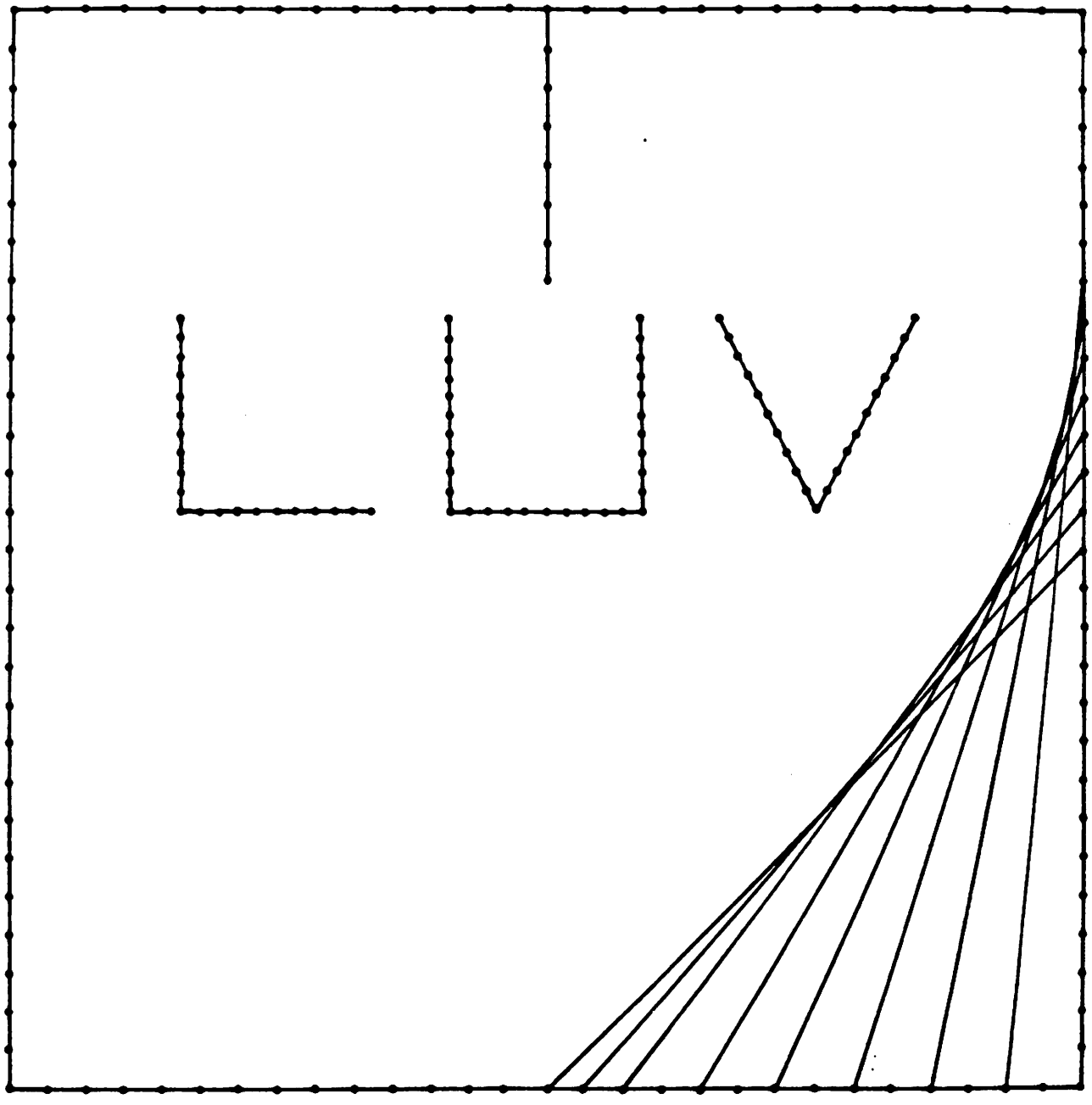
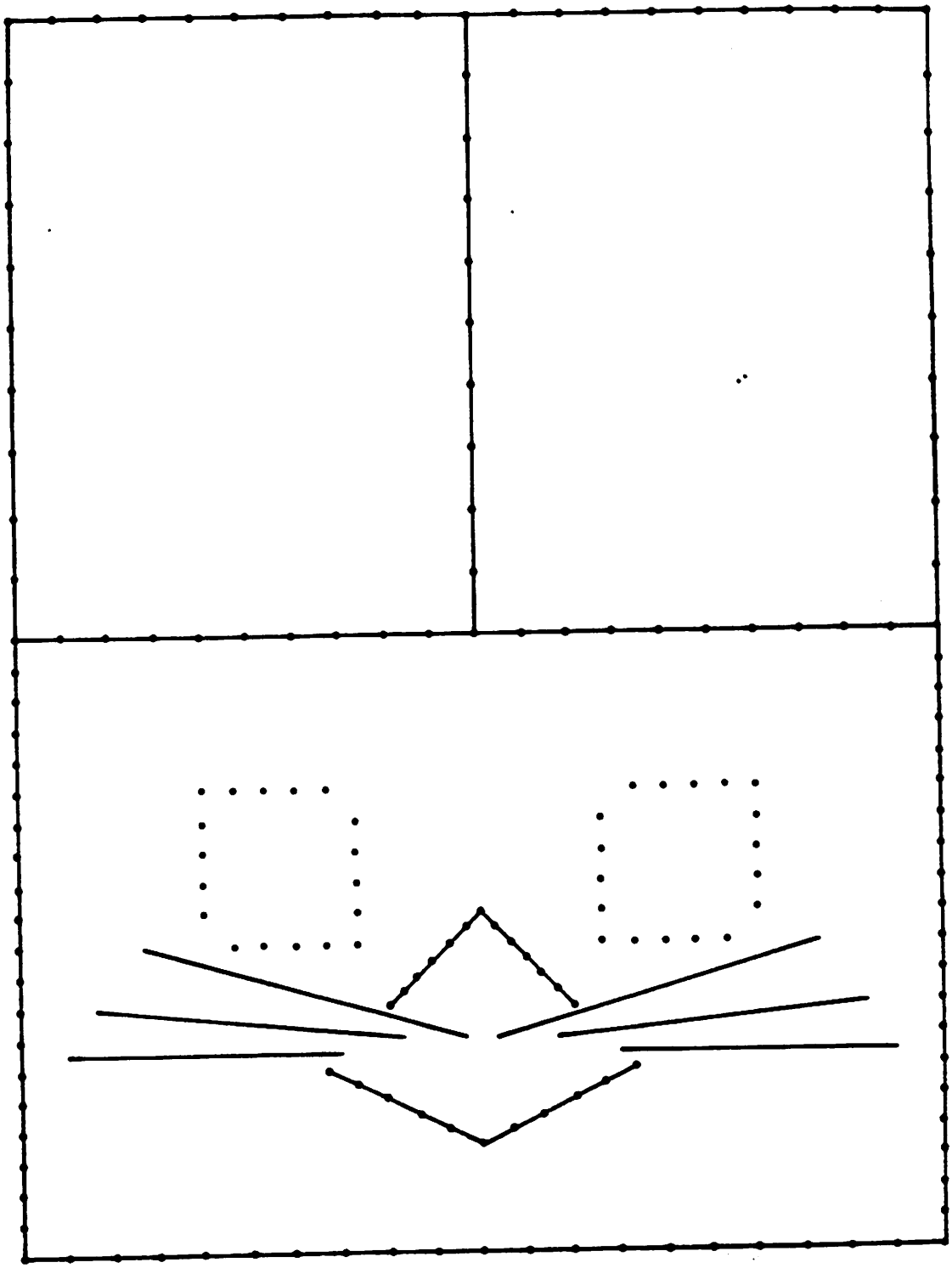
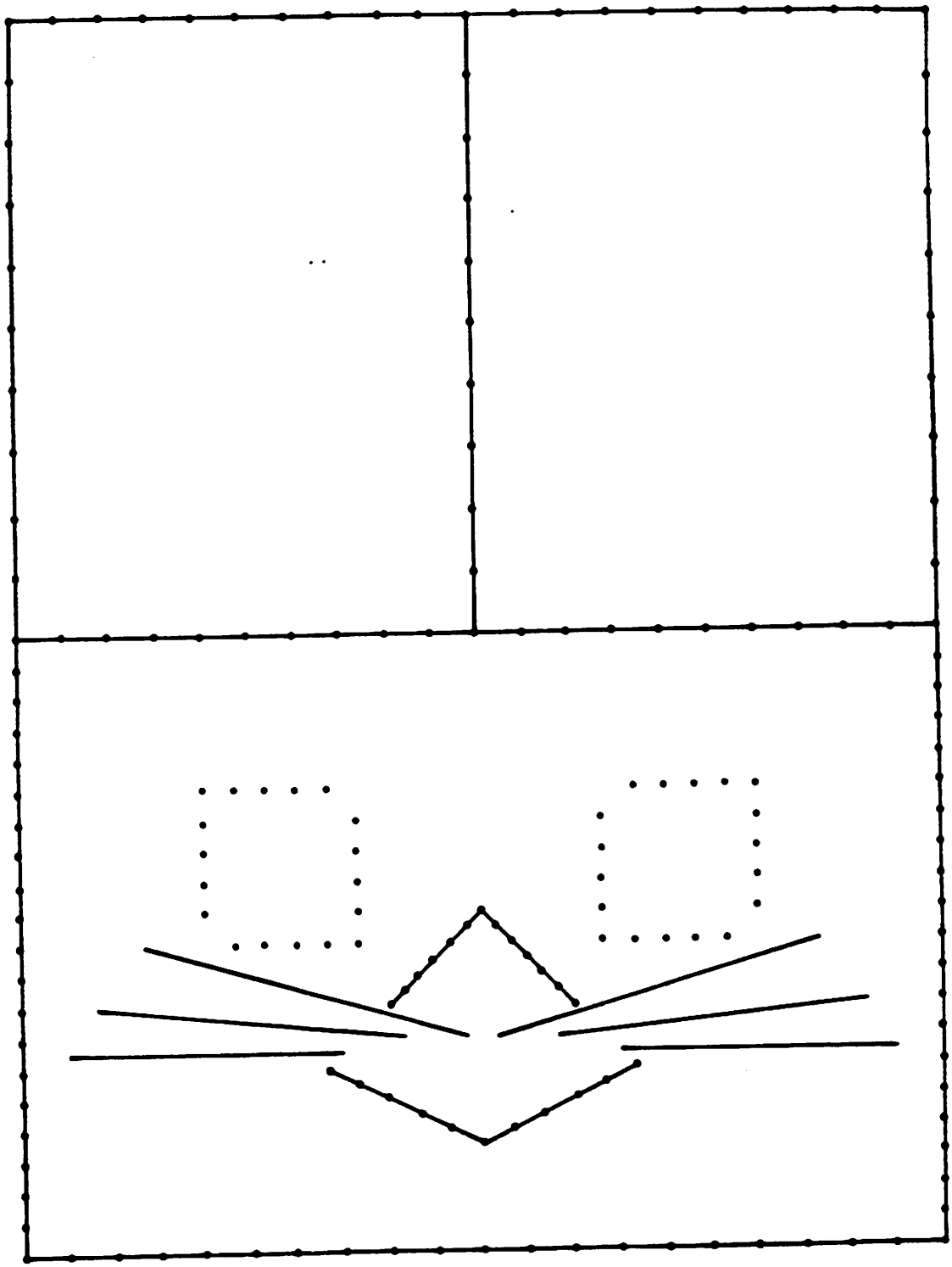


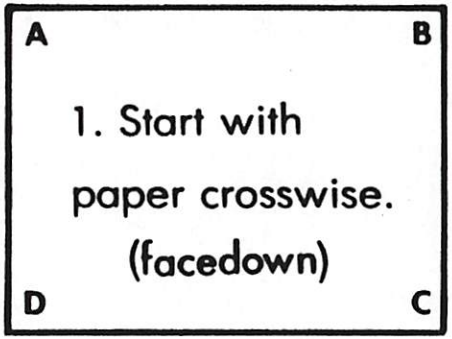




visible wax paper

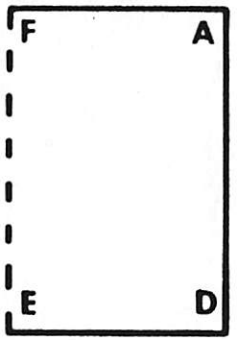
Pentagon

Use 8½ x 11 paper or any other that is close to 3:4 ratio.

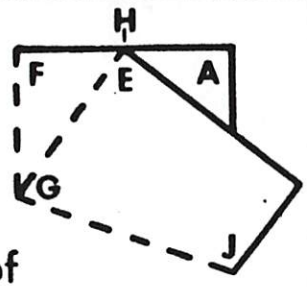


1. Start with paper crosswise. (facedown)

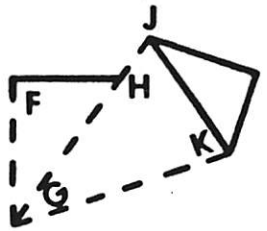
2. Fold in half, left over right.



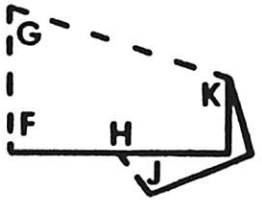
3. Match E to H, which is ½ the distance of F to A. Crease $\overline{GJ}$.



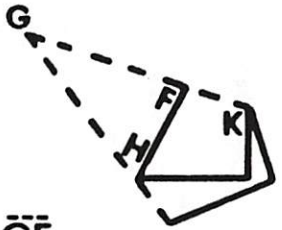
4. Bisect ∠EGJ by matching $\overline{GJ}$ to $\overline{GE}$. Crease on $\overline{GK}$.



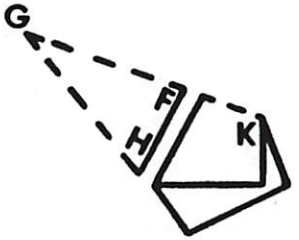
5. Turn over, flipping the bottom to the top.



6. Bisect ∠FGK by matching $\overline{GF}$ to $\overline{GK}$. Crease on $\overline{GH}$.



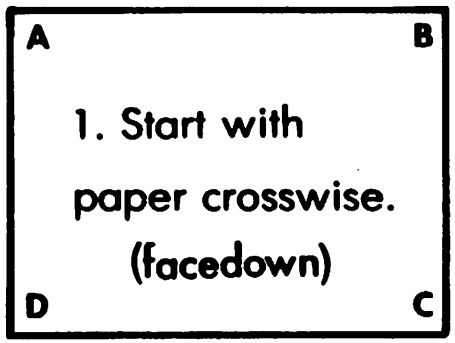
7. Cut on $\overline{HF}$.



8. Save and unfold △GFH.

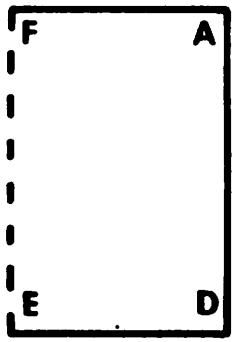
Pentagon

Use 8½ x 11 paper or any other that is close to 3:4 ratio.

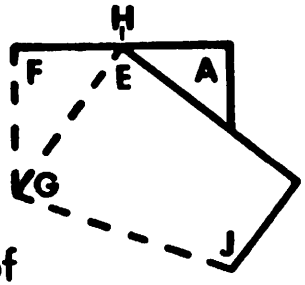


1. Start with paper crosswise. (facedown)

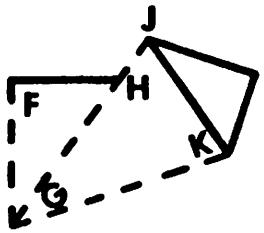
2. Fold in half, left over right.



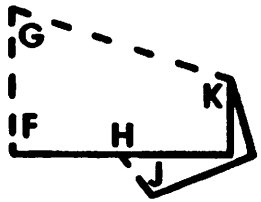
3. Match E to H, which is ½ the distance of F to A. Crease $\overline{GJ}$.



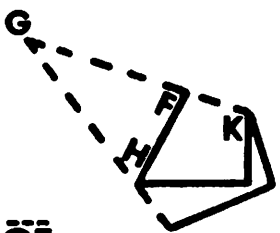
4. Bisect ∠EGJ by matching $\overline{GJ}$ to $\overline{GE}$. Crease on $\overline{GK}$.



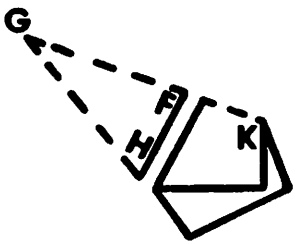
5. Turn over, flipping the bottom to the top.



6. Bisect ∠FGK by matching $\overline{GF}$ to $\overline{GK}$. Crease on $\overline{GH}$.



7. Cut on $\overline{HF}$.



8. Save and unfold △GFH.

Hexagon

1. Start with paper crosswise. (facedown)

2. Fold in half, left over right.

3. Fold in half again, folding the top down.

4. Fold in half once more, folding the top down again.

5. Unfold once.

6. Place lower left corner F on center fold and crease through upper left corner G.

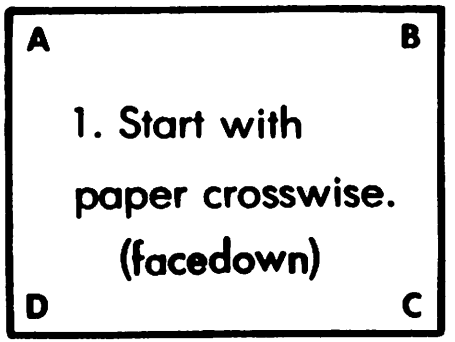
7. Turn

over, flipping the bottom to the top.

8. Bisect ∠JGH by matching $\overline{GJ}$ to $\overline{GH}$. Crease on $\overline{GF}$.

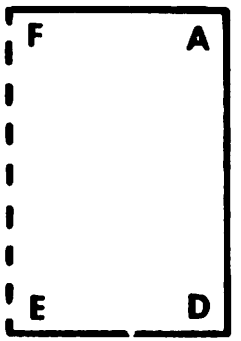
9. Cut on $\overline{JF}$. Save and unfold △GJF.

Hexagon

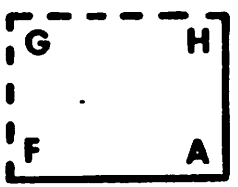


1. Start with paper crosswise. (facedown)

2. Fold in half, left over right.

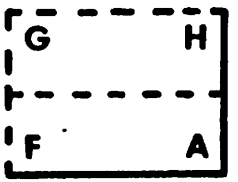


3. Fold in half again, folding the top down.

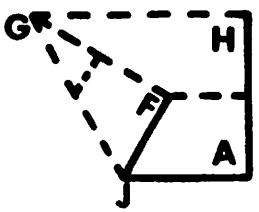


4. Fold in half once more, folding the top down again.

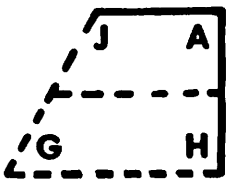
5. Unfold once.



6. Place lower left corner F on center fold and crease through upper left corner G.

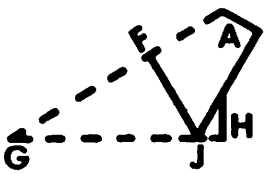


7. Turn



over, flipping the bottom to the top.

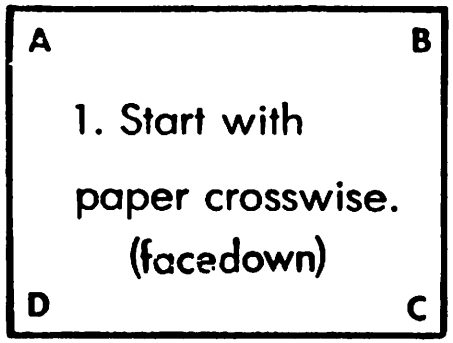
8. Bisect ∠JGH by matching $\overline{GJ}$ to $\overline{GH}$. Crease on $\overline{GF}$.



9. Cut on $\overline{JF}$. Save and unfold △GJF.

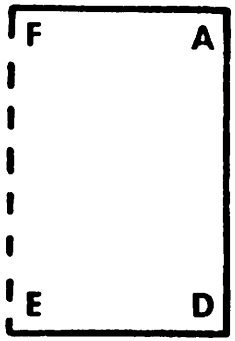
Heptagon

Use 8½ x 11 paper or any other that is close to 3:4 ratio.

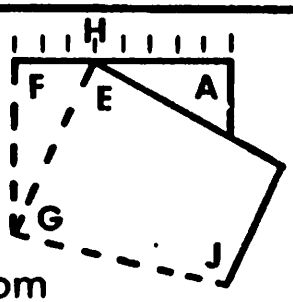


1. Start with paper crosswise. (facedown)

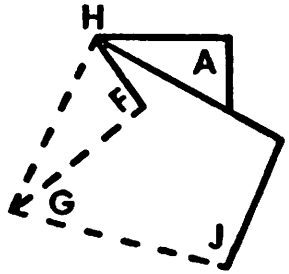
2. Fold in half, left over right.



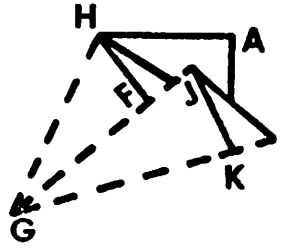
3. Match E to H, which is 3/8 the distance from F to A. Crease $\overline{GJ}$.



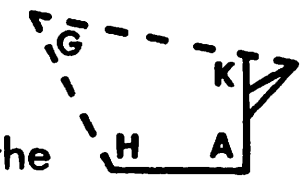
4. Fold △FGH down by creasing along $\overline{GH}$.



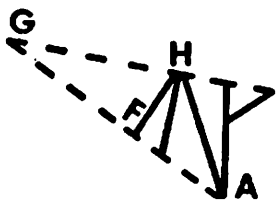
5. Bisect ∠FGJ by matching $\overline{GJ}$ to $\overline{JF}$. Crease on $\overline{GK}$.



6. Turn over, flipping the bottom to the top.



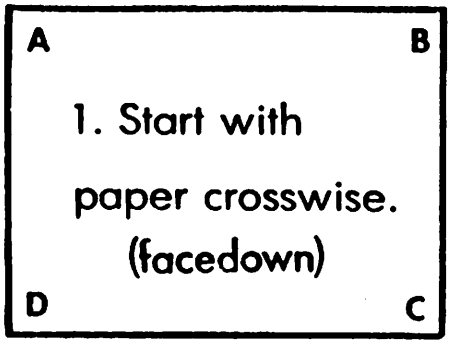
7. Bisect ∠KGH by matching $\overline{GH}$ to $\overline{GK}$. Crease on $\overline{GF}$.



8. Cut on $\overline{FH}$. Save and unfold △GFH.

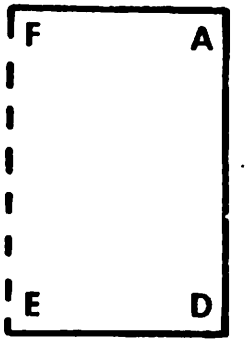
Heptagon

Use 8½ x 11 paper or any other that is close to 3:4 ratio.

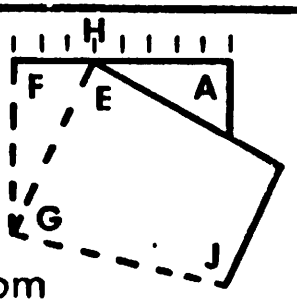


1. Start with paper crosswise. (facedown)

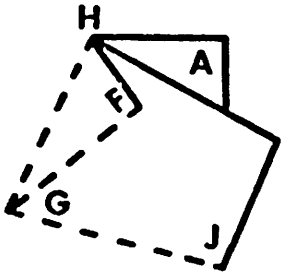
2. Fold in half, left over right.



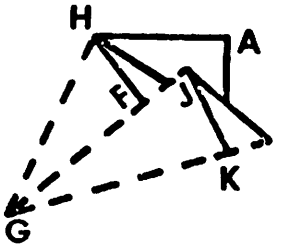
3. Match E to H, which is 3/8 the distance from F to A. Crease $\overline{GJ}$.



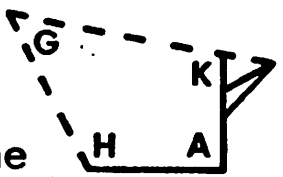
4. Fold △FGH down by creasing along $\overline{GH}$.



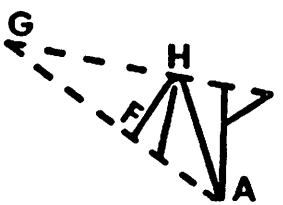
5. Bisect ∠FGJ by matching $\overline{GJ}$ to $\overline{JF}$. Crease on $\overline{GK}$.



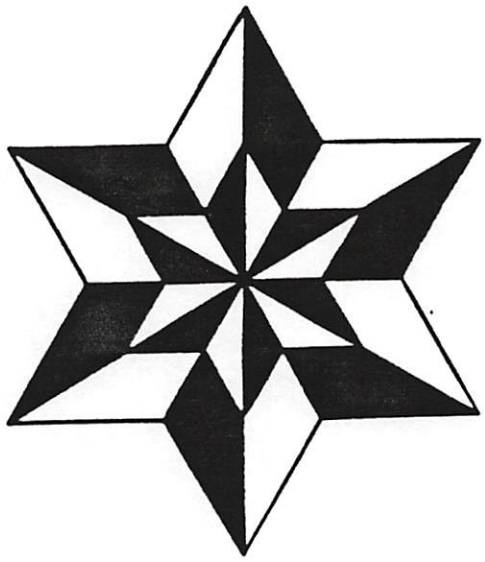
6. Turn over, flipping the bottom to the top.

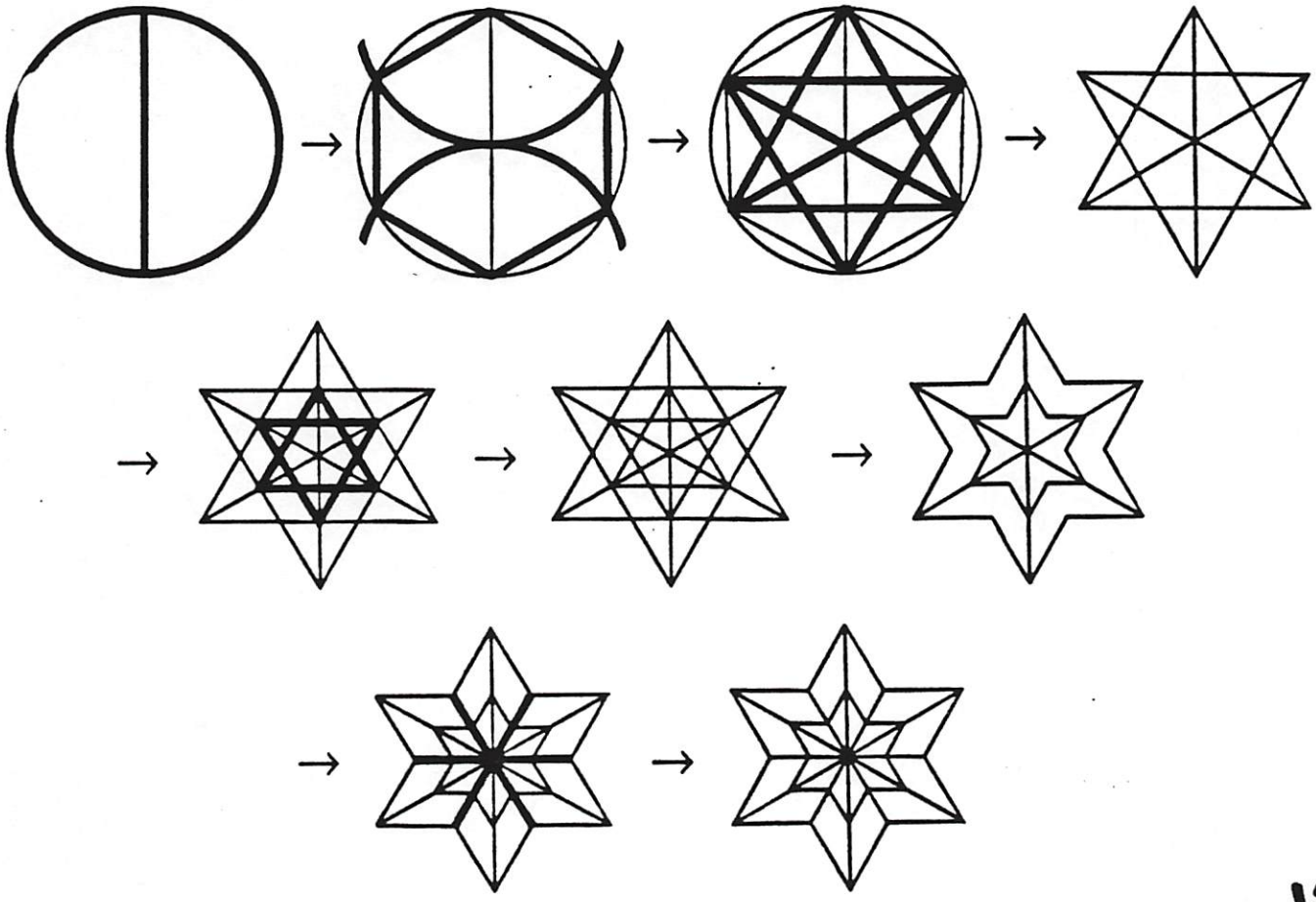


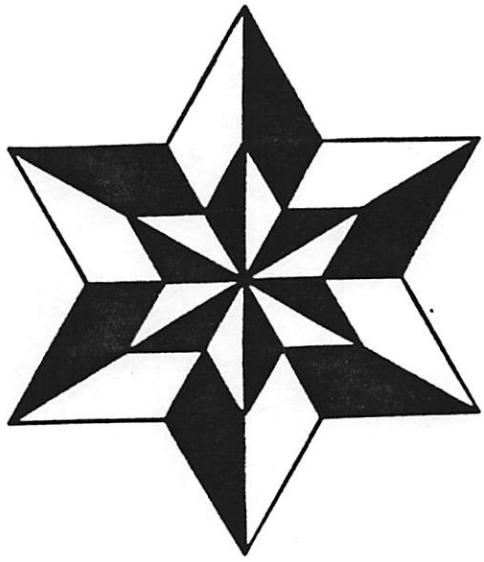
7. Bisect ∠KGH by matching $\overline{GH}$ to $\overline{GK}$. Crease on $\overline{GF}$.

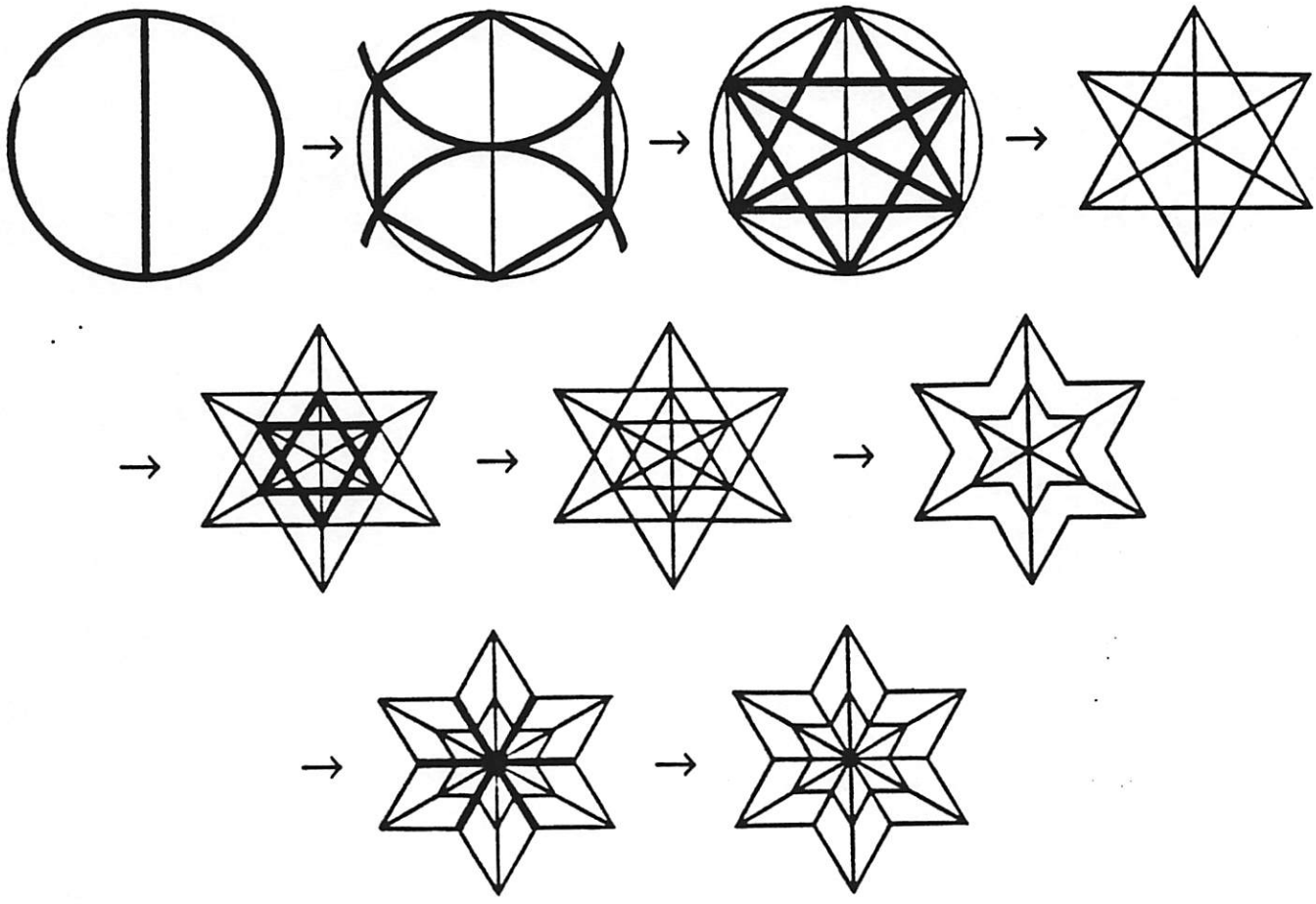


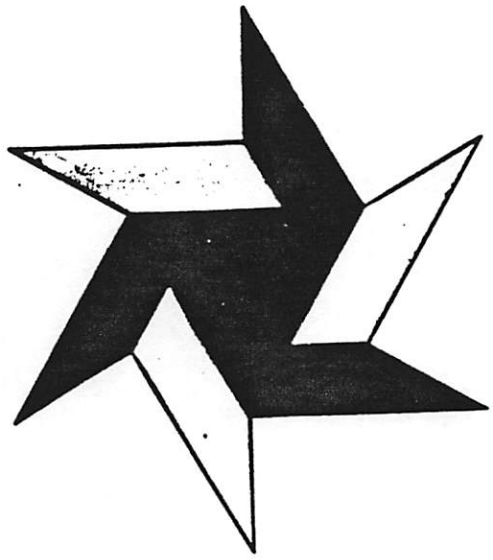
8. Cut on $\overline{FH}$. Save and unfold △GFH.

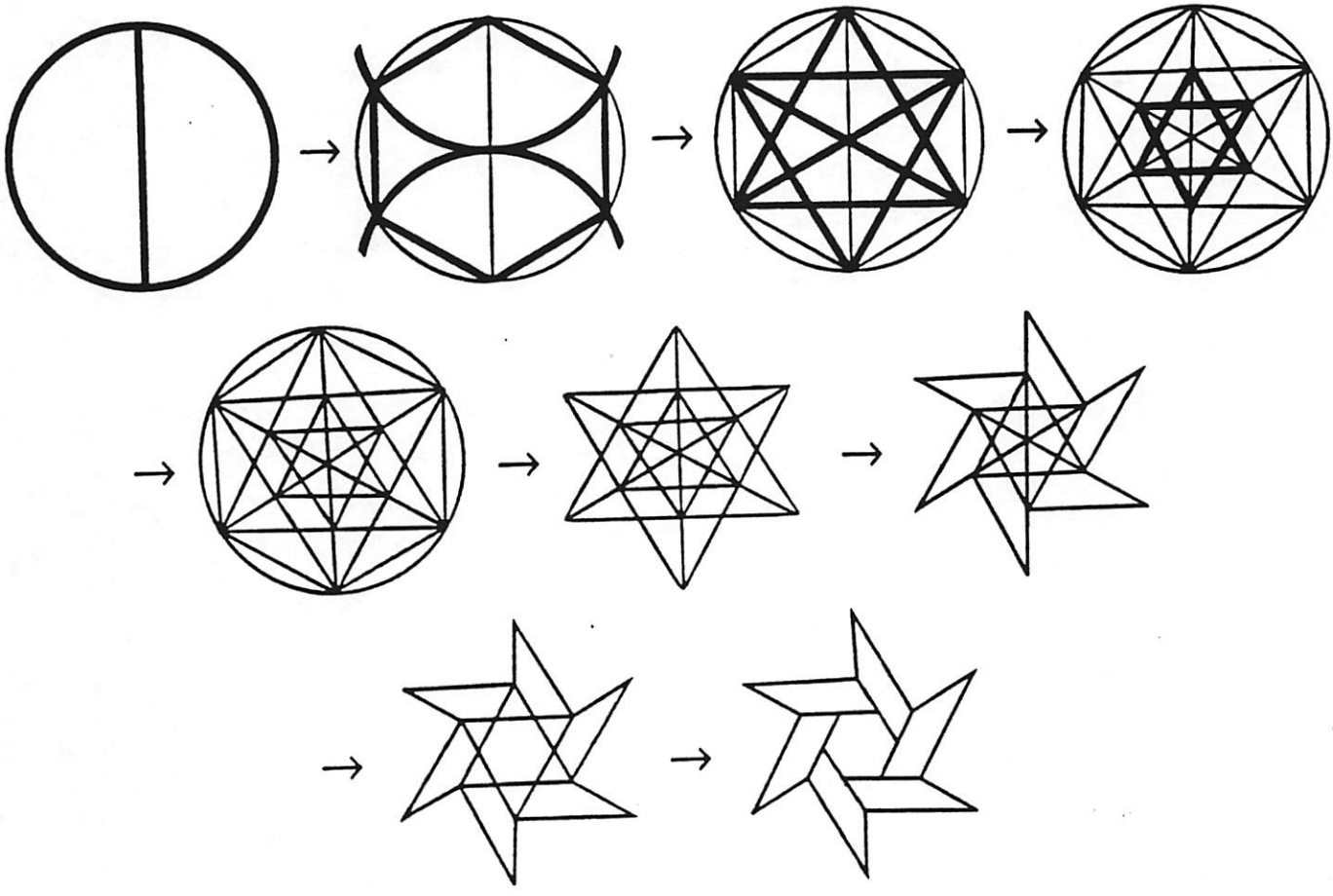


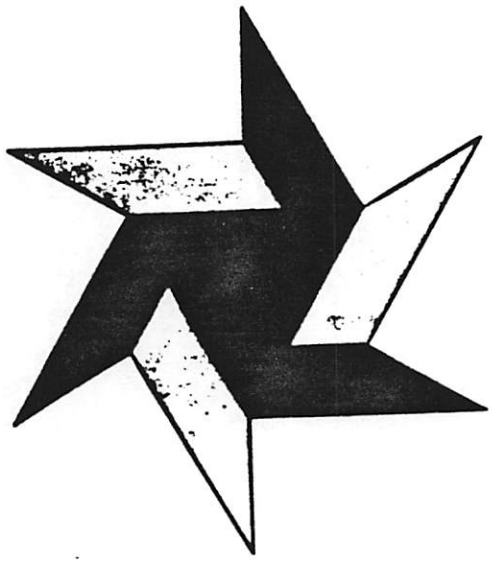


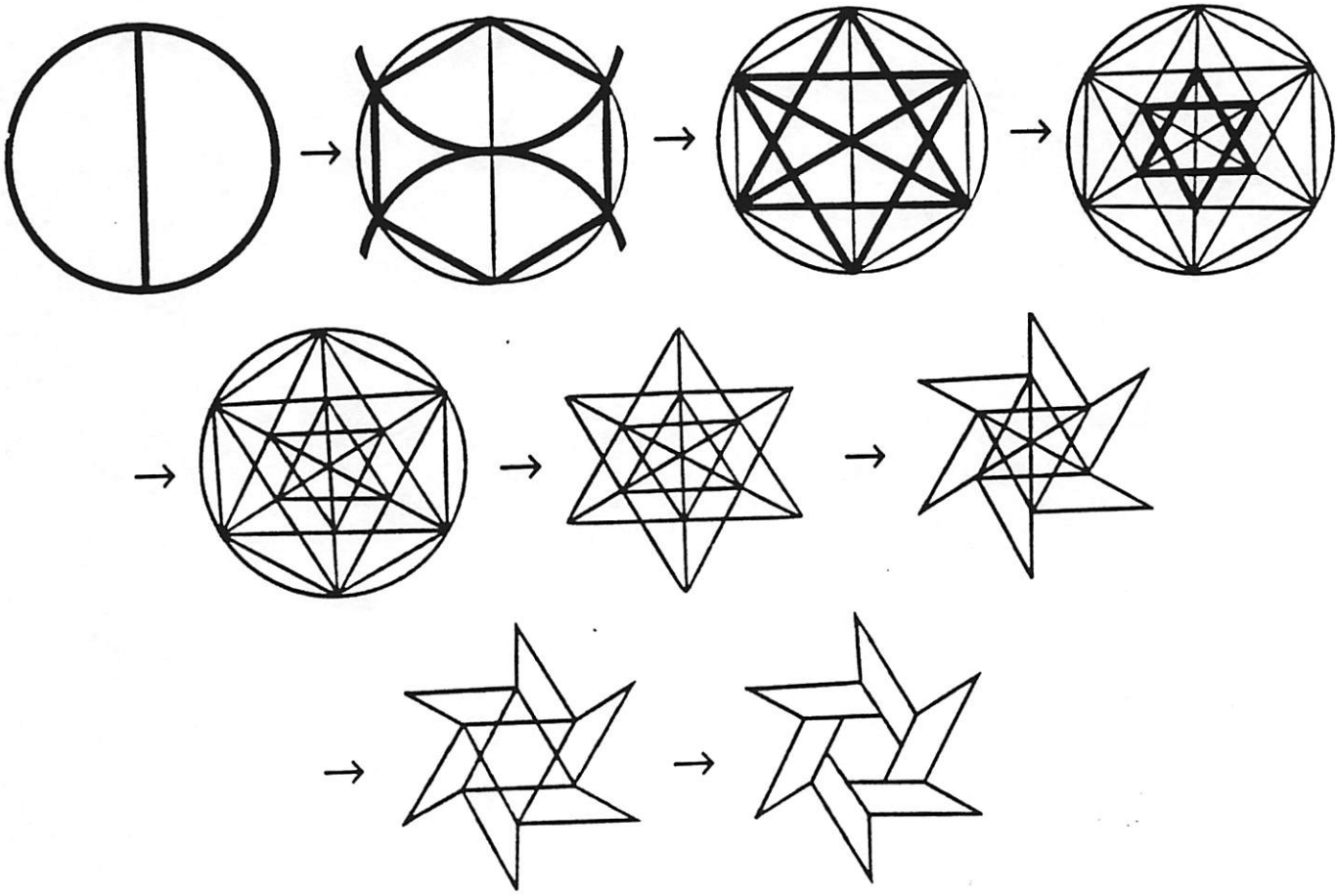












Astrobrites - Lasalle Paper

The Magic Circle!

Ted Ostrander and Arthur Wiebe

A simple circular piece of paper can teach a surprising number of geometric concepts! Your students will be continuously involved as they fold and unfold, observe, compare, and draw conclusions. By being engaged in a hands-on activity, students will experience geometric concepts in a real world context.

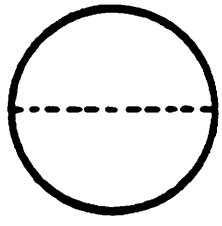
For this activity cut out circles about 25 centimeters (9-10 inches) in diameter out of newspaper or similar material. Each student and the teacher need a circle in order to act upon, feel, see, and discuss each step.

A circle is formed on a piece of paper by a line that is the same distance from a specific point called the center of the circle.

In this article the hands-on activities are indicated by bold type. The answers to the discussion questions are given in parentheses. It is recommended that each question be thoroughly discussed so students learn new terms, concepts, and facts.

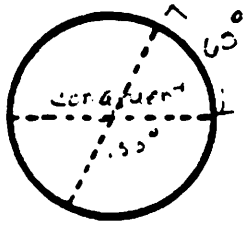
For use with students, take a few steps at a time. The sequence is presented here in its entirety only for the purpose of showing the broad scope that is possible. The first time through, it might be advisable just to do the folding as outlined in bold type. This could then be followed by studying the questions after each fold.

1. Using the paper circle, fold the circle in half.



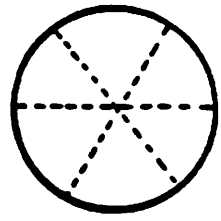
a. What is this new shape called? (Semi-circle)
b. What is its straight edge called? (Diameter)
c. Define a diameter. (The longest line segment with endpoints on the circle)
d. How much of the area of the circle is in the semi-circle? (One-half).
e. How can you find the center of the circle? (Fold another different semi-circle).

2. Open the circle. Fold a second semi-circle. Mark the point where the diameters intersect.



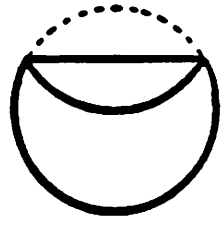
a. Open the circle. What can you say about the two diameters? (They intersect at the center of the circle, bisect each other and are congruent.)
b. What is the line segment that is one-half the diameter called? (Radius).
c. The plural of radius is radii. How many radii can you see? (Four)
d. A sector of a circle is formed by two radii and the arc connecting an endpoint of each. How many sectors do you see? (Four).
e. How do the shape and size of opposite sectors compare? (They are congruent: same size and same shape.)
f. How does the measure of opposite angles compare? (It is the same. The angles are congruent.)
g. What shape do any two adjacent sectors form? (Semi-circle).
h. What is the sum of any two adjacent arcs? (180 degrees or a semi-circle.)
i. If two adjacent sectors are combined, how does their area compare with the area of the circle? (It is one-half the area of the circle.)

3. Fold a third semi-circle.



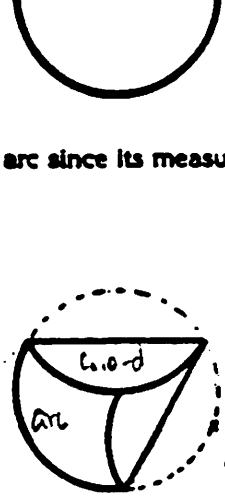
a. What can you say about the three diameters? (They are congruent and intersect in the center of the circle.)
b. How many radii do you see? (Six)
c. Compare the radii. (They are congruent.)
d. How many sectors do you see? (Six)
e. What shape do any three adjacent sectors form? (Semi-circle).
f. Complete this statement: "Any fold that passes through the center of the circle forms a _____?" (Diameter)
g. How many pairs of opposite angles are there? (Three)
h. How does the measures of opposite angles compare? (They are the same.)

4. Open up the circle and fold one edge of the circle to the center and fold.



a. What is the straight line segment formed by the fold called? (A chord. All folds with endpoints on the circle not passing through the center are called chords of the circle.)
b. What is a special name for the arc that remains? (Major arc since its measure is more than 180 degrees.)

5. Make a second fold to the center so that the end of the new chord meets an end of the first chord. Crease. The figure now resembles an ice cream cone.



a. What elements form its boundary? (Two chords and an arc)

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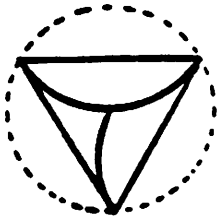
continued on page 12

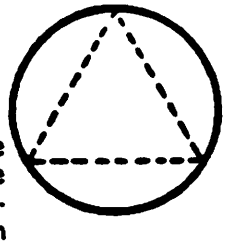
b. What part of the circle is in the intercepted arc? (⅓)
c. What is the measure of the arc? (120 degrees)
d. What is the angle formed by the two chords called? (Inscribed angle)
What is the measure of the inscribed angle? (60 degrees)
f. How does the measure of the angle compare with the measure of the arc? (It is ½ the measure of the intercepted arc.)

6. Make a third fold to the center so that the ends of the new chord meet the remaining ends of the previous two chords. Crease.



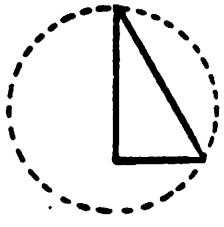
a. What is the shape that is formed called? (Equilateral triangle)
b. How do the measures of the sides of the equilateral triangle compare? (They are congruent.)
c. How do the angles of the equilateral triangle compare? (They are congruent.)
d. Is the area of the equilateral triangle more or less than one-half the area of the circle? (Less than one-half since the triangle is completely double covered everywhere and partially triple covered.)
e. Given that the sum of the measures of angles of a triangle is 180 degrees, what is the measure of each of the angles? (60 degrees)
In this figure a vertex is formed where two chords meet. How many vertices do you see? (Three)

7. Open up the circle. Note that the equilateral triangle is inscribed in the circle; that is, each vertex is on the circle.



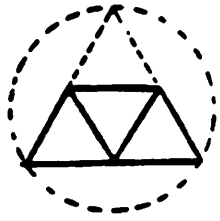
How does the area of the equilateral triangle compare with the area of the circle outside the triangle? (It is less than one-half since the outside will cover all of the triangle at least twice and some of it three times.)

8. Fold back into an equilateral triangle. Find the midpoint of one side. Make a fold passing through this midpoint and the opposite vertex.



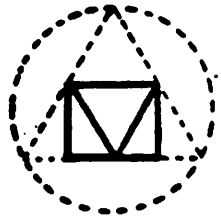
a. What type of triangle is formed? (Right triangle)
b. What is the measure of each of its angles? (90, 60, and 30 degrees.)
c. The longest side of this right triangle is called the hypotenuse. The shorter two sides are called legs. How do the lengths of the legs compare? (The shorter is one-half the hypotenuse or longest side.)
d. What is the measure of the angle opposite the hypotenuse? (90 degrees)
e. What is the measure of the angle opposite the shorter leg? (30 degrees)
f. What is the measure of the angle opposite the longer leg? (60 degrees)
g. How does the area of the right triangle compare with that of the equilateral triangle? (It is one-half that of the equilateral triangle.)

9. Open up into the equilateral triangle. Bring one vertex of the triangle to the opposite mid-point of a side and crease well.



a. What type of figure is formed? (Isoceles trapezoid)
b. Compare one set of opposite sides of the trapezoid. What do you observe? (In one set the sides are congruent but not parallel. In the other the sides are parallel but not congruent: one is twice the length of the other.)
c. Compare the second set of opposite sides of the trapezoid. What do you observe? (The other condition above).
d. How many triangles do you see? (Three are visible and and a fourth is under the center triangle.)
e. How do the four triangles compare? (They are congruent.)
f. How does the area of the trapezoid compare with that of the first large equilateral triangle? (It is three-fourths that of the triangle.)
g. Explain your reasoning. (Since the first triangle has been divided into four congruent triangles and three form the trapezoid, the area of the trapezoid is ¾ that of the first triangle.)
h. How does the area of the orginal equilateral triangle compare with that of the trapezoid? (It is ⅔ that of the trapezoid.)
i. How does the area of one of the four equilateral triangles compare with that of the trapezoid? (They are ⅓ the area of the trapezoid.)
j. How does the area of one of the four triangles compare with that of the large equilateral triangle? (It has ¼ the area.)
k. How does the perimeter of the trapezoid compare with that of the large equilateral triangle? (It is ¾ as long.)

10. Fold the second and third vertices to the same midpoint.



a. What type of figure is formed? (Rectangle)
b. How does the height (or width) of this rectangle compare with the height of the original triangle? (½ as high)
c. How does the length of this rectangle compare with length of the base of the original triangle? (½ as long)

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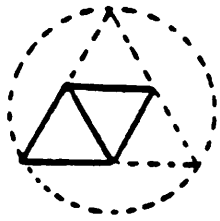
d. If the base of the triangle is b and the height of the triangle is h, what are the dimensions of this rectangle? (½b by ½h)
What is the area of the rectangle? (¼bh)
What, then, is the area of the original triangle? (Twice as much or ½bh)

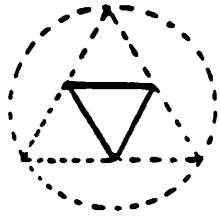
g. Note that the vertices of the triangle are all together. What is the sum of the measure of all three vertices? (A straight angle or 180 degrees)

11. With the trapezoid, fold one of the outside triangles over the center triangle.



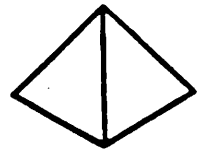
a. What figure is formed? (Rhombus)
b. How does the measure of the sides of the rhombus compare? (They are equal.)
c. What can you say about opposite sides? (They are congruent and parallel.)
d. How do opposite angles compare? (They are congruent.)
e. How many small triangles do you see? (Two)
f. The area of the rhombus is what part of the area of the large triangle? (One-half)
g. The area of the rhombus is what part of the area of the trapezoid? (Two-thirds)
h. How does the area of the rhombus compare with that of the small triangles? (It is twice as large.)
Compare the area of the large triangle to that of the rhombus. (It is twice as large.)
j. Compare the area of the trapezoid to that of the rhombus. (It is ⅔ as large.)
k. How does the perimeter of the rhombus compare with that of the large equilateral triangle? (It is ⅔ or ⅔ as long.)
l. How does the perimeter of the rhombus compare with that of the trapezoid? (It is ⅔ as long.)
m. How does the perimeter of the large equilateral triangle compare with that of the rhombus? (It is ⅔ or 1.5 times as long.)
n. How does the perimeter of the trapezoid compare with that of the rhombus? (It is ¾ or 1.25 times as long.)
A rhombus is a subset of the set of parallelograms.

12. Fold the remaining outside triangle over the center triangle.



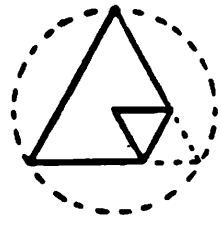
a. What figure is formed? (Equilateral triangle)
b. How does the area of this triangle compare with that of the rhombus? (It is one-half as large.)
How does the area of this triangle compare with the right triangle folded earlier? (The area of the triangle is ½ that of the right triangle.)
d. How does the perimeter compare with that of the rhombus? (It is ¾ that of the rhombus.)
e. How does the perimeter of the triangle compare with that of the trapezoid? (It is ⅔ that of the trapezoid.)
f. How does the perimeter of the triangle compare with that of the large equilateral triangle? (It is ½ that of the large triangle.)
g. How does the perimeter of the trapezoid compare with that of the small equilateral triangle? (It is ⅔ or 1⅓ as long.)
h. How does the perimeter of the rhombus compare with that of the small triangle? (It is ⅔ or 1⅓ as long.)
i. How does the perimeter of the large equilateral triangle compare with that of the small triangle? (It is twice as long.)

13. Open the figure to the original triangle. Fold the original triangle so the vertices meet to form a three-dimensional pyramid.



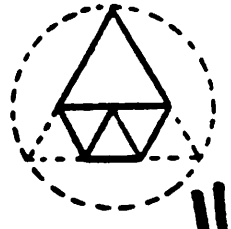
a. What is this figure called? (Tetrahedron. Tetra means four. It has four faces.)
b. What is the surface area of the tetrahedron if the area of the original triangle is 1? (Also 1)
c. What is the surface area of the tetrahedron if the area of one of the small triangles is 1? (4)
d. What is the surface area of the tetrahedron if the area of the trapezoid is 1? (⅔)
e. What is the surface area of the tetrahedron if the area of the rhombus is 1? (2)

14. Open the figure to the original triangle. Fold one vertex to the center of the circle. (Make the folds in Steps 13, 14, and 15; then return to the condition in this step. The triangles will be easier to visualize.)



a. What new figure is formed? (Isosceles trapezoid) Explain the answer.
b. How does the area of this trapezoid compare with the original triangle? (It is ⅔ as large.)
c. How does the perimeter of this trapezoid compare with that of the original triangle? (It is ⅔ as long.)
d. How does the short base of the trapezoid compare with the long base? (It is ⅓ as long.)

15. Fold a second vertex to the center.

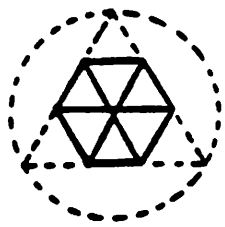


a. What is the new figure called? (Pentagon)
b. How does the area of the pentagon compare with that of the original triangle? (It is ⅔ as large.)

continued on page 16

c. How does the perimeter of the pentagon compare with that of the original triangle? (It is ⅞ as long.)
d. How does the area of the pentagon compare with that of the isosceles trapezoid in previous case? (It is ⅞ as large.)
e. How does the perimeter of the pentagon compare with that of the isosceles trapezoid? (It is ⅞ as long.)

16. Fold the third vertex to the center of the circle.



a. What is the new figure called? (Regular hexagon)
A regular hexagon has all sides and interior angles congruent.
b. How many small triangles do you see? (Six)
c. How does the area of the hexagon compare with that of the original triangle? (It is ⅚ or ⅔ as large.)
d. How does the perimeter of the hexagon compare with that of the original triangle? (It is ⅚ or ⅔ as long.)
e. How does the area of the hexagon compare with that of the pentagon? (It is ⅚ as large.)
f. How does the area of the hexagon compare with the trapezoid in this sequence? (It is ⅚ or ¾ as large.)
g. How does the perimeter of the hexagon compare with that of the pentagon? (It is ⅚ as long.)
h. How does the perimeter of the hexagon compare with that of the trapezoid in this sequence? (It is ⅚ or ¾ as long.)
i. How does the area of the hexagon compare with that of the first trapezoid, not the one in this sequence? (The area of the hexagon is ⅔ or $\frac{8}{12}$ that of the triangle and the trapezoid is ¾ or $\frac{9}{12}$ that of the triangle. Therefore, the area of the triangle is ⅚ that of the trapezoid.)
j. How does the area of the hexagon compare with that of the rhombus? (The area of the hexagon is $\frac{8}{12}$ that of the triangle and the area of the rhombus is ½ or $\frac{6}{12}$ that of the triangle. Therefore, the area of the hexagon is ⅚ or ⅘ that of the rhombus.)

It is clear at this stage that additional rather difficult comparisons could be examined. These are left up to the discretion of the teacher.

17. Open up the triangle. Tuck one of the small triangles at one of the vertices into the small triangle at one of the other vertices. Then tuck the triangle at the remaining vertex underneath the other two to form a three-dimensioned figure.

a. What is the new figure called? (It is a truncated tetrahedron. Truncated means it has a part that has been cut off.)
b. If the original triangle had an area of 1, what is the area of (1) the bottom base? (¼)
(2) the top base? (⅛)
(3) a side face or wall? (¼−⅛) (Note that together one side face and the top base are congruent to the bottom base.)
c. What is the total surface area of the truncated tetrahedron?
$[¼ + ⅛ + 3(¼ - ⅛)] = [\frac{3}{24} + \frac{3}{24} + 3(\frac{6}{24} - \frac{3}{24})] =$
$[\frac{12}{24} + 3(\frac{3}{24})] = \frac{21}{24} = ⅞.$
d. Remembering Polya's advice that "It is better to work one problem five ways than to work five problems one way" can you think of another way to solve this problem? (When the truncated tetrahedron was formed, we hid exactly two of the small triangles. All the rest of the original triangle is to be found in the bases and side faces. Each of the hidden triangles had ⅛ the area of the original triangle. Therefore, ⅞ of that area was lost, leaving ⅞.)

18. Build a truncated tetrahedron that will just fit on top of this truncated tetrahedron.

7×7 | 4×4
4×4

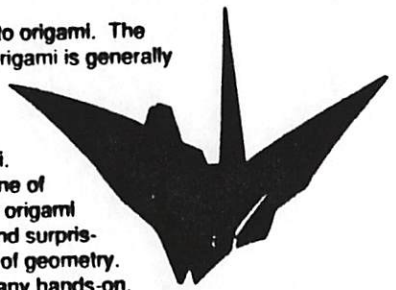
UNIT ORIGAMI

Introduction

"Understanding something intellectually and knowing the same thing tactilely are very different experiences."

— Tomoko Fusè

This booklet is designed as a classroom complement and guide to Tomoko Fusè's book *Unit Origami*. It includes specific folding exercises, ideas for getting started, and practical classroom tips.



Most people have had some exposure to origami. The paper crane is recognized universally, and origami is generally thought of as an art form or a craft. Tomoko Fusè, who studied under Master Toyoaki Kawai, has literally added another dimension to the traditional forms of origami. She is recognized at home and abroad as one of the most original and exciting of the modern origami experts. Her creations are not only lovely and surprising, but also very applicable to the teaching of geometry.

Fusè's book, *Unit Origami*, presents many hands-on, multi-sensory, tactile geometric experiences. Origami, as presented in the book, can be a powerful manipulative activity in a geometry classroom. The materials are simple, the geometry is inherent, and the end product is satisfying and beautiful.

Who Does Origami in Japan?

(You might want to read or summarize the following paragraphs for your students.)

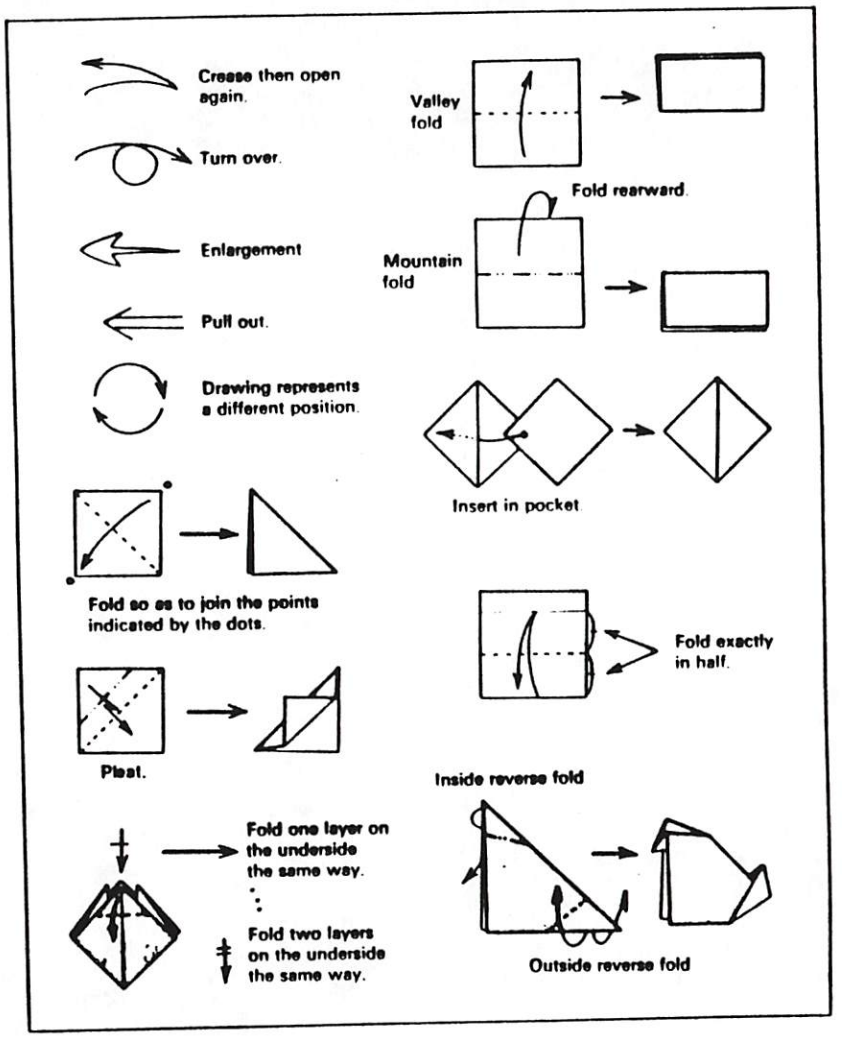
The word origami is written in Japanese characters on the inside cover of this booklet. It means paper-folding (*ori* — to fold; *gami* — paper). Origami is thought to have started about one thousand years before you were born. Since paper was very expensive in those days, origami could only be used for ceremonies, not for pure fun and enjoyment. Besides, the folds were made in such a formal way that they were very difficult to learn.

Eventually, origami became a part of everyday Japanese life. In fact, it became a craft for children. Mothers and grandmothers taught it to their five and six year old children and grandchildren, and they still do. In this way, origami has been handed down for centuries.

Origami plays an important part in certain Japanese festivals. For the Star Festival (Tanabata) on July 7th, origami decorations are hung on a branch of bamboo along with narrow strips of paper on which wishes are written. On May 5th, which used to be Boys' Day and is now Children's Day, children use large pieces of paper to fold Samurai helmets.

Key to Folding Directions

These instructions were reproduced from *Unit Origami* for easy reference when you are folding Fusè's figures. As you have probably noticed, we used a slightly different system in this guide — one we felt would be more familiar to geometry teachers.



What Is Unit Origami?

Unit origami, a new type of paper-folding, refers to figures that are made by creating more than one origami unit and joining the parts together. For instance, making the skeleton of an octahedron, which is shown below, involves folding 6 square pieces of paper into identical units. These units are then assembled by tucking one piece into another like a puzzle. The finished product consists of three intersecting squares, each a different color.

The octahedron requires 6 units — 3 colors, 2 squares each. Try folding the unit according to the directions below. Then see if you can figure out the interesting way the pieces fit together. If you decide to teach it to your students, give them a chance to admire the intersecting planes. This figure teaches three-dimensional geometry!

Folds You'll Need

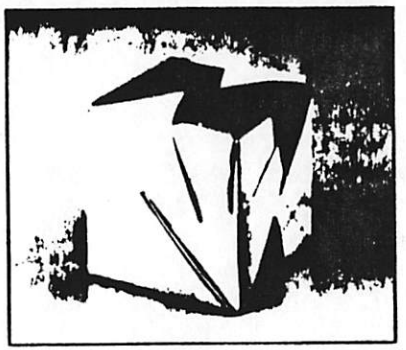
Valley Fold **Mountain Fold**

Making the Unit

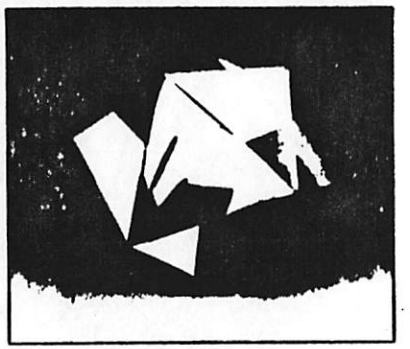
Skeleton of Octahedron

Assembling the units is often a trial and error process — like putting together a puzzle. The key to this puzzle is that each unit has one pair of opposite flaps that tuck into other units, and another pair of opposite flaps that other units tuck into. The finished product appears as three intersecting squares, each a different color.

Folding Activities to Get Your Feet Wet



Cube

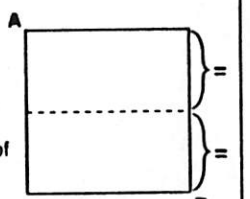


Stellated Octahedron

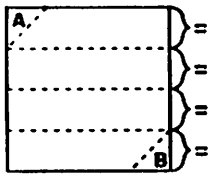
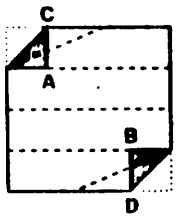
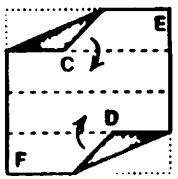
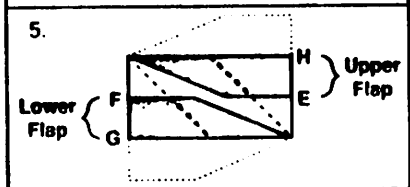
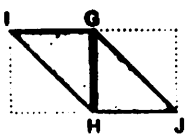
In *Unit Origami* the folds range from simple to very demanding. Before delving into Fusè's book, you might want to start with two figures that are relatively easy to fold — a cube and a stellated octahedron. Both of these figures are based on Jeanne Shimizu Yost's "star building unit," and can serve as a useful stepping stone for Fusè's activities.

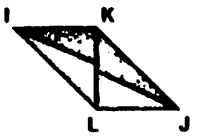
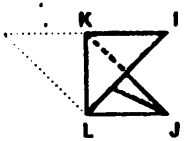
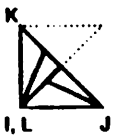
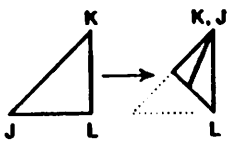
Below you will find instructions for folding the star building unit, for demonstrating these folds in front of a class, and for assembling the cube and the stellated octahedron. Although these exact activities are not included in Fusè's book, they were inspired by Kunihiko Kasahara's unit and cube assembly on page 72 of *Unit Origami*.

Folding the Star Building Unit

Demonstration Steps	Geometric Concepts/Skills*
1. Use a valley fold to fold the paper into two congruent rectangles. Start with white side of the paper face up. 	*What can you say about the area of one of the small rectangles compared to the area of the large square? (1/2 of the area of the large square)*

*Insert these comments into your demonstration as either questions or running commentary.

2. Fold each small rectangle in half 	*What 's the area of the smallest rectangle compared to the area of the large square? (1/2 of 1/2, or 1/4 of the area of the large square)* *How can you describe the 3 folded lines on your paper? (parallel)*
3. Fold down diametrically opposed corners as shown. 	*What kinds of triangles have you made? (isosceles right triangles)* *What's the name of the 6-sided figure you have made? (hexagon) Is it regular? (no) Why or why not?* *Put your finger on a point in the middle of the paper and rotate the figure 180°. This figure has rotational symmetry of 180°.*
4 	*What kinds of triangles have you made? (obtuse isosceles triangles) What are the measures of their angles? (22 1/2–22 1/2–135)* *Unfold the the triangle you made for a minute. Do you see how your folds bisected the angle formed by the leg and the hypotenuse of the right isosceles triangle?*
5. 	*Is the fold down the middle of the paper a horizontal line of symmetry? (no) Why or why not?*
6. 	*You have 2 congruent triangles. What kind are they? (isosceles right)* *What shape do they form together if you turn the figure over? (parallelogram)* *What can you say about the areas of these two congruent triangles? (they're the same)*

7. Open up the parallelogram. Tuck IGH under the upper flap. Tuck GHJ under the lower flap. The resulting figure looks like this. 	*Does this figure have rotational symmetry of 180°? (yes)*
8. 	
9. The creases in steps 8 and 9 are very important. They must be tight and firm. 	*What kind of triangle is the large triangle you have formed? (right isosceles triangle)*
10. Flip the triangle over. Fold J to K. 	*What can you say about the area of the small triangle you just formed compared to the area of the parallelogram? (1/4 the area of the parallelogram)*
11. The unit is now complete. Leave the unit in its "N" shape. Do not flatten it. 	*How does the area of the parallelogram compare to the area of the square you see in the center of it? (twice the area of the square)*

Getting Started on Unit Origami in the Classroom

Origami and Geometry

Implementing unit origami in your classroom can mean rich, hands-on geometry experiences for your class. Students involved in origami have the opportunity to use the vocabulary of geometry in context and to discuss concepts as they fold origami figures together. There are innumerable mathematical skills and concepts inherent in origami, including:

- ✓ spatial visualization
- ✓ three-dimensional geometry
- ✓ line and rotational symmetry
- ✓ polygons, Platonic solids, and other polyhedra
- ✓ parallel, perpendicular, and intersecting lines
- ✓ intersecting planes
- ✓ congruence and similarity
- ✓ area and volume
- ✓ angles and angle bisectors
- ✓ definitions of types of triangles

Getting Started

When you are ready to integrate origami into your curriculum, you will need to keep in mind that it is usually best to start folding figures right away. Too much time spent flipping through a book such as *Unit Origami* might make you feel somewhat overwhelmed. Origami is a hands-on craft, and the understanding of how to fold a piece only seems to come from working it out step-by-step. It requires an open mind and the patience to fool around with the folds until you discover the "secret." Inevitably, the results are deeply satisfying. Fusè includes a paragraph entitled "On Not Giving Up" in which she admits that even *her* first versions are wrinkled and messy. She entreats the reader to persevere. If you haven't already done so, you might want to try the activities on pages 2 to 7 of this guide.

Implementing the book will require trying out the figures at home first. You will want to sort through the options in *Unit Origami*, considering the abilities of your students and your own level of expertise. You'll also need to rethink the directions prior to demonstrating in the classroom. Rest assured that all visual directions are summarized on page 12 of Fusè's book, which is reproduced at the end of this booklet. Fusè's index can also be helpful as it includes the number of units required for each figure.

During the exploratory stage of your planning, keep in mind that Chapters 5 and 6 of *Unit Origami* provide manageable figures for initial investigations in a geometry classroom. These include the tetrahedron, cube, cuboctahedron, and icosahedron.

Specific Activities for Getting Started

Below are some concrete suggestions for getting started. Each paragraph describes polyhedra that can be constructed from a particular origami unit. The first paragraph includes figures that you can make from the star-building unit and that are included in this booklet. The last two paragraphs describe figures that are found in Chapters 5 and 6 of *Unit Origami*. Page numbers are included for easy reference.

Figures Made from the Star Building Unit

(This guide, pages 3 to 7)

The star building unit is easy to fold. The directions for this unit and the figures made from it are found in this guide.

Star Unit

- Folding the *basic unit*
  See this guide, pages 3-5.
- Assembling the *cube* (6 units)
  See this guide, page 6.
- Assembling the *stellated octahedron* (12 units)
  See this guide, page 7.
- Using 9, 12, 15, 18, or more star building units to form polyhedra
  For example, 9 units will form a double cube (rectangular pyramid).

Figures Made from the Parallelogram Unit

(Chapter 5, *Unit Origami*)

These units are similar to the star building unit, but they connect in a slightly different way. All of these figures are included in *Unit Origami*.

Parallelogram Unit

- Folding the *basic unit*
  See *Unit Origami* page 134.
- Assembling the *tetrahedron* (6 units)
  See *Unit Origami* pages 134 to 135.
- Assembling the *cube* (6 units)
  See *Unit Origami* page 136.
- Assembling and connecting 3 *tetrahedrons*
  See *Unit Origami* pages 138 to 139.

Figures Made from Flat Units

(Chapter 6, *Unit Origami*)

Large Square Flat Unit

The polyhedra below are made of the large square flat unit which is very easy to fold and/or the equilateral-triangular flat unit which is more complex but accessible. Directions are included in *Unit Origami*.

Equilateral Triangular Flat Unit

- Folding the *basic units*
  See *Unit Origami* page 176 for square and page 180 for triangle.
- Assembling the *cube* (6 square units)
  See *Unit Origami* page 177.
- Assembling the *cuboctahedron* (6 square and 8 triangle units)
  See *Unit Origami* page 178.
- Assembling the *icosahedron* (20 triangle units)
  See *Unit Origami* page 180 to 181.

Practical Classroom Tips

What supplies will I need?

There are several options for paper:

- Origami paper (supplied through Key Curriculum Press or available at art stores)
- Colored ditto or mimeograph paper
  (Cut the paper 8 1/2" by 8 1/2" or 5 1/2" by 5 1/2")
- Wrapping paper or pages from old magazines cut into squares

You may also need some tape, glue, or paper clips to stabilize some finished figures. (See "How can I demonstrate..." below for supply options for demonstrations.)

How much time should I set aside?

Unit origami entails time for demonstration, for folding multiple units, and for assembling figures. You'll want to leave at least one whole period for the construction of most unit-origami figures.

What preparation is required?

You will need to fold each figure at home first so that you are confident about its construction. At that time, you can think about the geometric concepts that the figure teaches. You will also need to make sure you have enough origami paper.

What is an effective way to group my students?

Origami requires patience and can be a bit lonely for a student to tackle individually. Pairing students and then arranging them in groups of 4 will enable them to discuss and interpret the directions together. Assembling figures is also often easier with four hands. Note that each partner can construct her or his own figure or the pair can construct a shared figure.

How can I demonstrate to the whole class?

One of the most effective ways to demonstrate is using an overhead projector and wax paper. The paper is translucent and the folds are easy to see. As an alternative, using a large piece of paper to demonstrate is a bit more cumbersome, but it works. Fadeless® brand bulletin board paper cut into large squares works well, and has the advantage over wax paper that you can differentiate the colored and white sides. (It has the further advantage that it's available at most school sites.) It comes in rolls or flat sheets (unfortunately, not square) in various widths from 12 to 48 inches. 24 inches is a good demonstration width. Flat sheets are easier to cut and handle but come only in 12 and 18 inch widths. If all else fails, you can always walk around the classroom, demonstrating with a small square. It can be helpful to display a sample of each individual folding step on a piece of cardboard and to have completed models for each group to study.

You can start by demonstrating slowly, step-by-step on the overhead. At the end of your demonstration, those who have the idea can go on to make as many duplicate units as are required by the figure. Meanwhile, you can demonstrate one more time, at a faster pace.

Your role switches at that point. You can begin circulating around the room, listening in as students teach each other and intervening only when necessary. Students whose fine motor skills and spatial visualization are not as advanced may need you at that time.

Some students will be ready to assemble the units. As you circulate, you can teach the fastest person in each foursome how to assemble the units. That person then becomes the teacher for the rest of the four. If a group of four is having difficulty, a neighboring group can assist them. Origami is a fertile ground for cooperative learning! (An alternative is to train leaders beforehand, and put one leader in each foursome.)

What do I do if a figure requires many units?

There are several alternatives if a figure requires 12, 15, or even 30 units. Groups can form an assembly line to hasten the folding and/or construction process. Squares can be taken home and brought back to class. Or each group can make one group-figure.

How do I explain the noise coming from my room?

There is a difference between classroom noise that is social chatter and noise that results from discovery, experimentation, and an exchange of ideas. Origami makes geometry come alive through hands-on activity and purposeful discussion.

Where can I learn more origami?

Unit Origami is likely to keep you busy for awhile, but many other origami books are available that describe different shapes and offer different perspectives. Three of particular interest are listed below:

Fusè, Tomoko, *Origami Boxes*, Japan Publications, 1989

Unit Origami is a compilation from a whole series of unit origami books by Fusè in Japanese. *Origami Boxes* is an English version from that series.

Kasahara, Kunihiko, *Origami Omnibus*, Japan Publications, 1988

A huge work with folds for everything from animals to masks to polyhedra. One large chapter is devoted to constructing polyhedra using unit origami. Another chapter, called Origami to Make You Think, discusses the mathematics of many folds. Mathematical relationships — areas, ratios, square roots — are highlighted throughout.

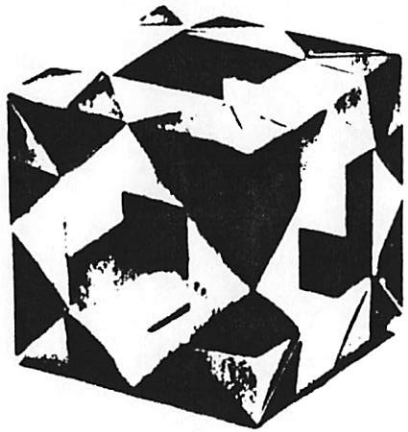
Kasahara, Kunihiko and Takahama, Toshie, *Origami for the Connoisseur*, Japan Publications, 1987

For when you really get good. Check out the single-sheet polyhedra.

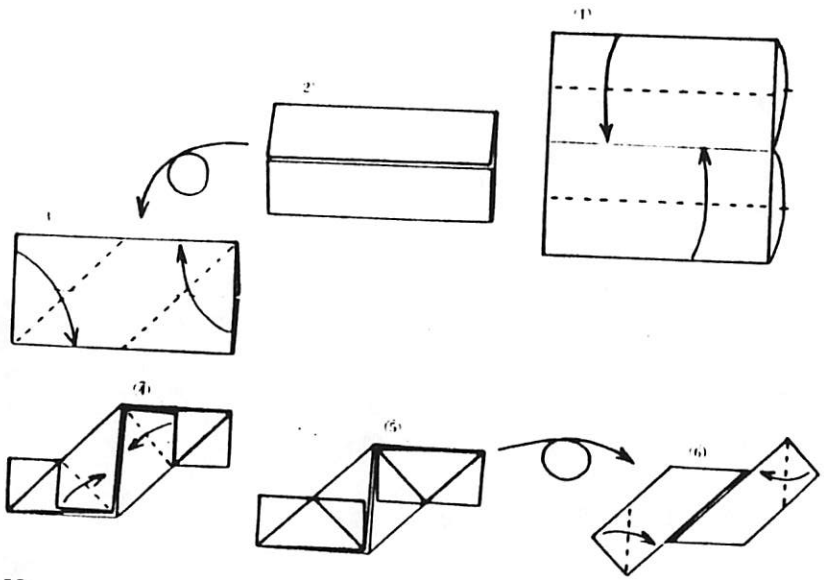
Open Frame I—Bow-tie Motif

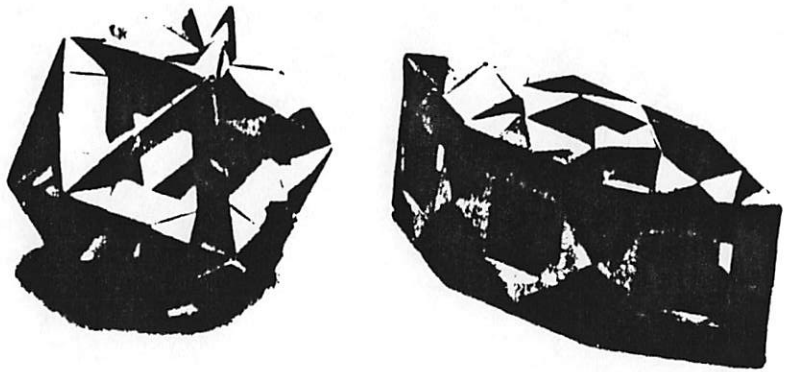
Although the centers of the individual sides tend to bulge upward in large solid figures made this way, the finishing is clean and strong and the final forms are beautiful and reflect the true nature of origami. I especially like the bow-tie motif appearing on the surfaces.

Using the forms shown in "Polyhedrons Summarized" on p. 238, devise your own variations.

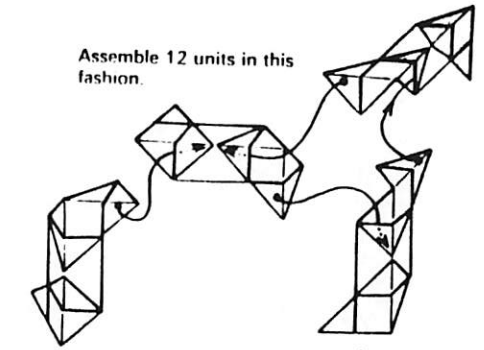


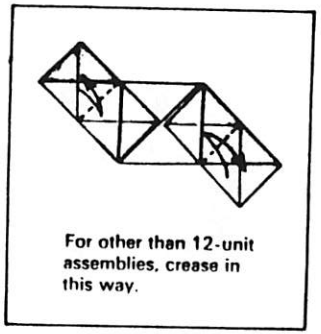
Open tower, 12-unit assembly

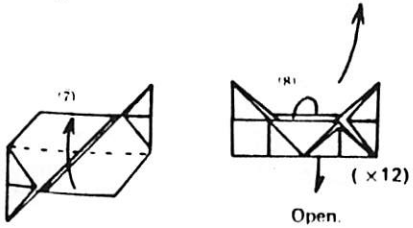


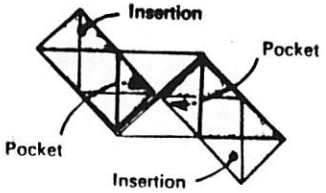


Assemblies of 30 (left) and 22 (right) units









Open Frame I—Bow-tie Motif

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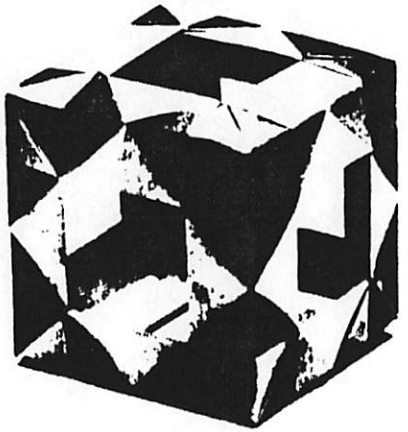
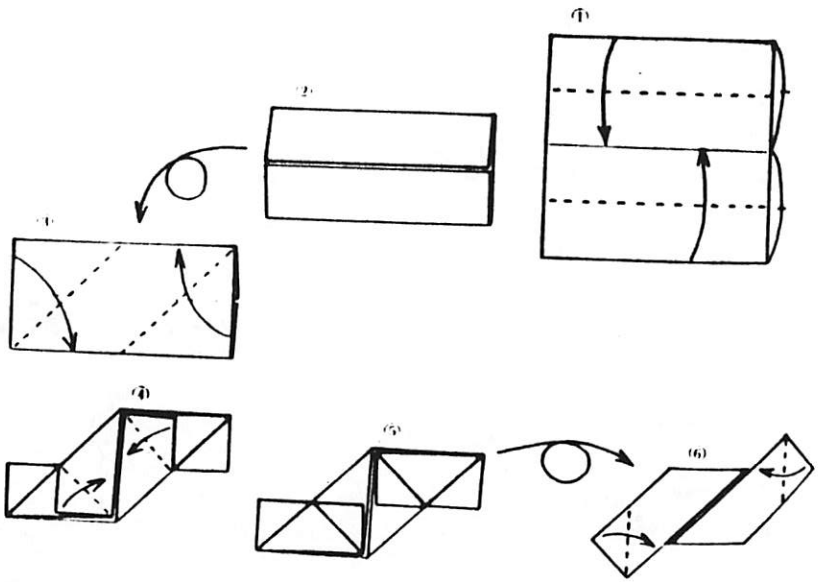
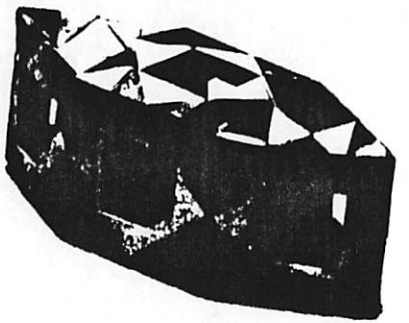


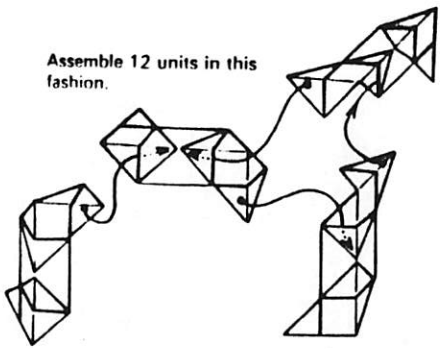
Open tower, 12-unit assembly

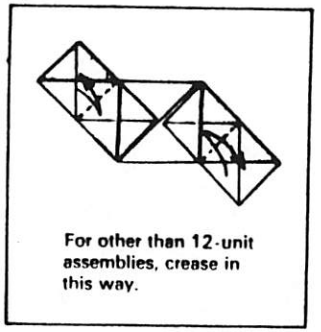




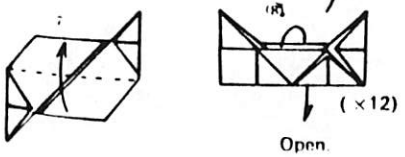
Assemblies of 30 (left) and 22 (right) units

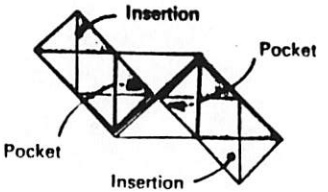
Assemble 12 units in this fashion.

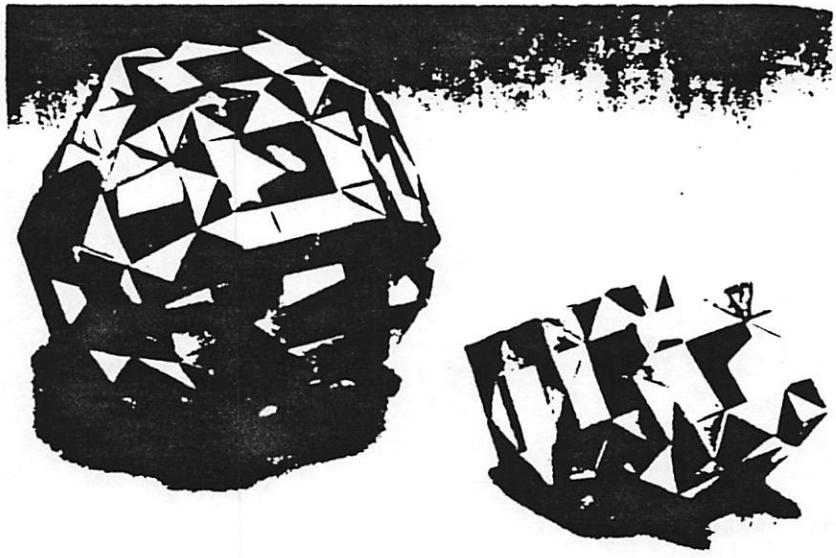




For other than 12-unit assemblies, crease in this way.





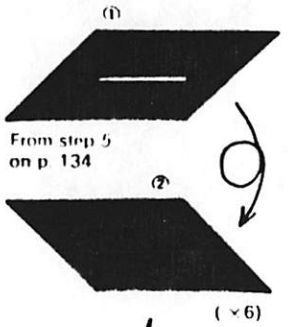


Assembly of 48 units (left) and 2 12-unit assemblies connected (right)

Assembly of 60 units

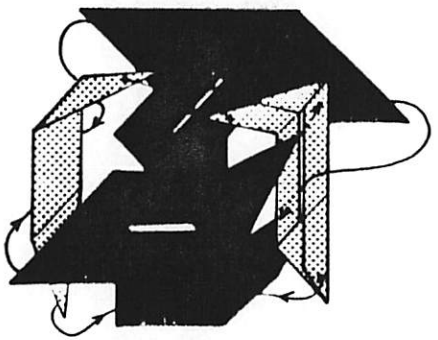
Bird Cube 6-unit Assembly

(by Kunihiko Kasahara)



Their designer Kunihiko Kasahara has christened the cubes with the easy-to-remember nicknames of bird and pinwheel because of the patterns formed by creases and slits on their surfaces. They and the simplified Sonobè unit on p. 72 are well known.

Referring to "Polyhedrons Summarized" on p. 238, work out various spherical assemblies using the kinds of creases shown in the box below.

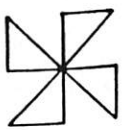


Bird cube 6-unit assembly

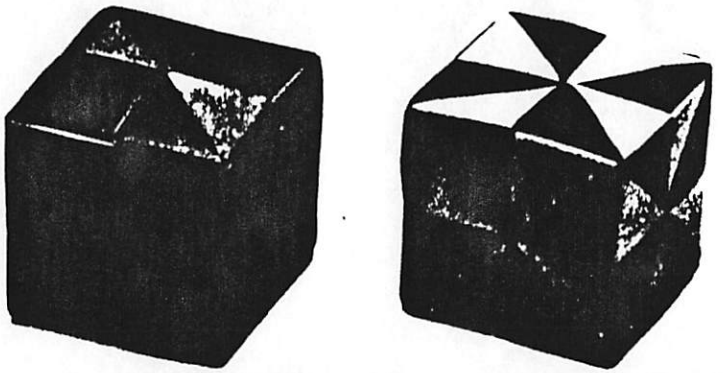
For a spherical assembly, crease as shown here.

Bird pattern

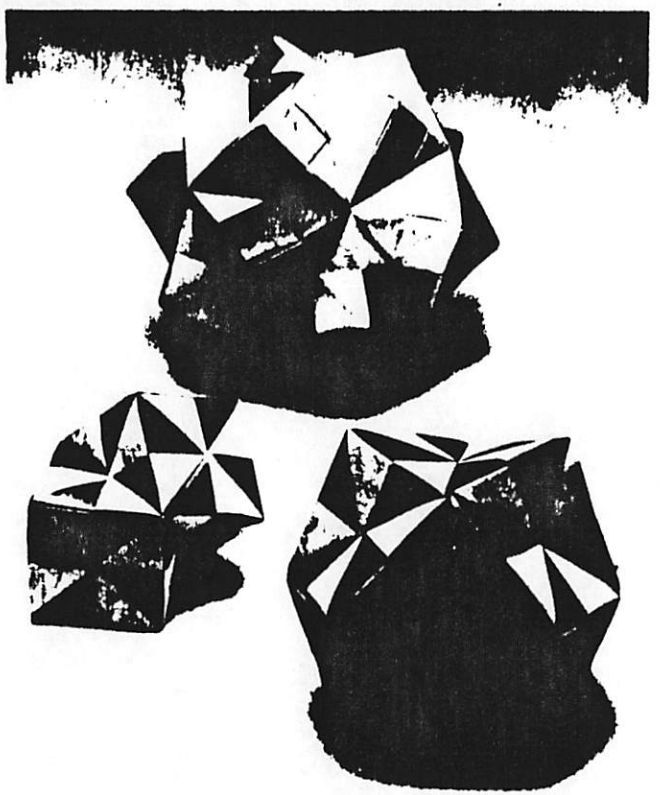
Pinwheel pattern



Appearing to wrap around the cube edges, this combination of squares and triangles is the form that gives the bird cube its name.



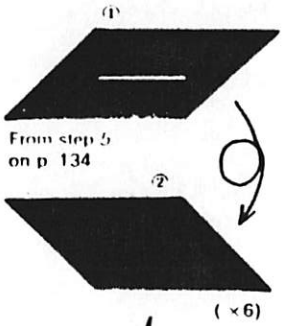
▲ Bird cube 6-unit assembly (left) and pinwheel cube 6-unit assembly (right)



▶ Bird 30-unit assembly (top), pinwheel 9-unit assembly (middle), and pinwheel 12-unit assembly (bottom)

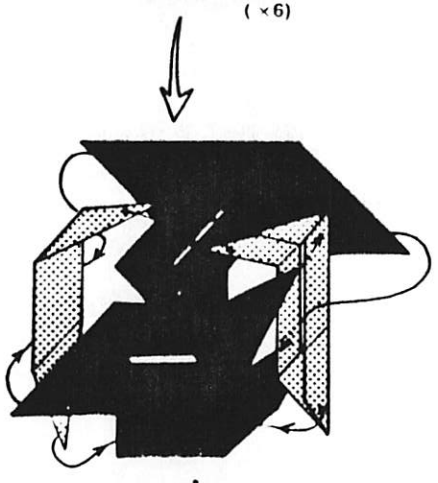
Bird Cube 6-unit Assembly

(by Kunihiko Kasahara)



Their designer Kunihiko Kasahara has christened the cubes with the easy-to-remember nicknames of bird and pinwheel because of the patterns formed by creases and slits on their surfaces. They and the simplified Sonobé unit on p. 72 are well known.

Referring to "Polyhedrons Summarized" on p. 238, work out various spherical assemblies using the kinds of creases shown in the box below.

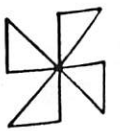


Bird cube 6-unit assembly

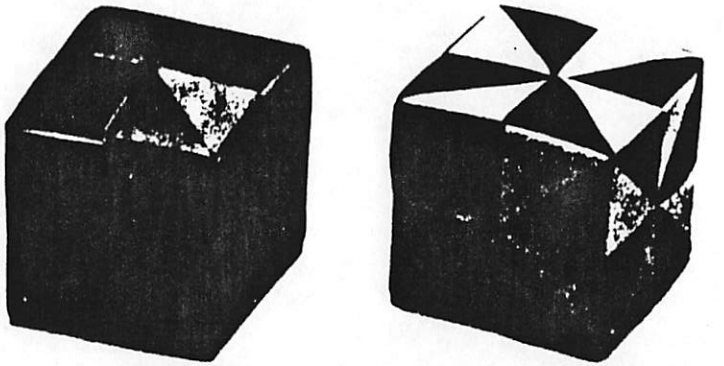
For a spherical assembly, crease as shown here.

Bird pattern

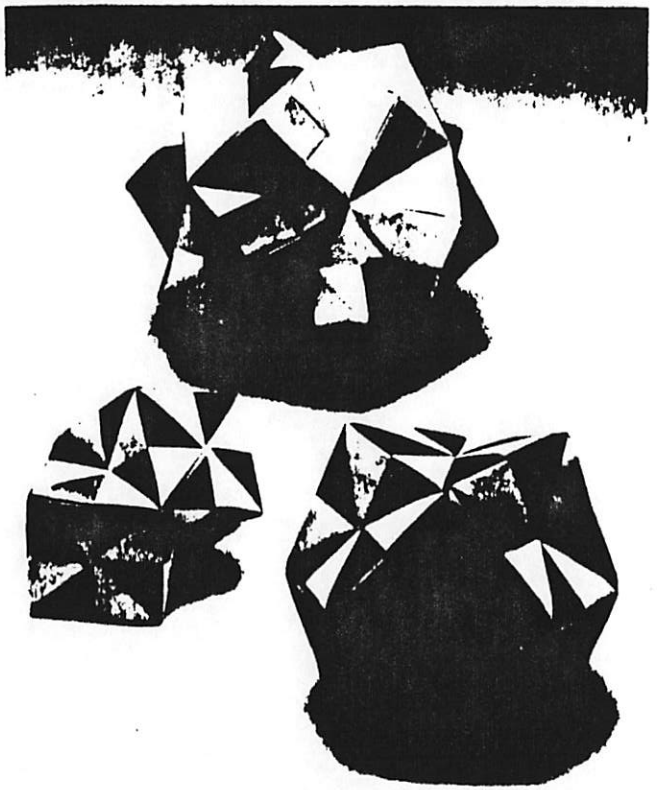
Pinwheel patter



Appearing to wrap around the cube edges, this combination of squares and triangles is the form that gives the bird cube its name.



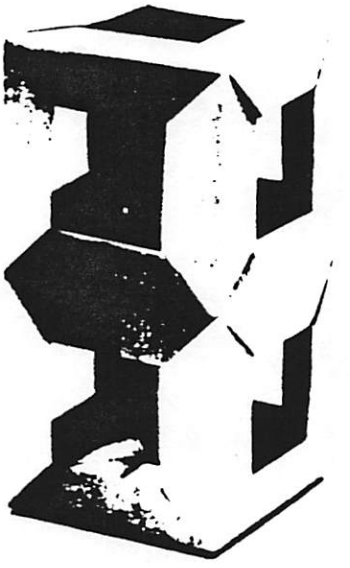
▲ d cube 6-unit sembly (left) and -wheel cube 6- assembly ght)



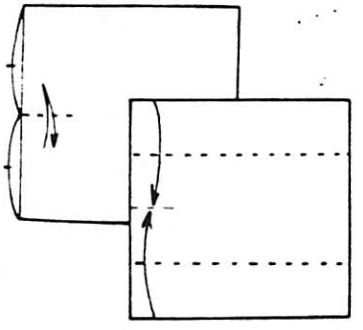
▶ Bird 30-unit ssembly (top), inwheel 9-unit ssembly (middle), nd pinwheel 12- nit assembly bottom)

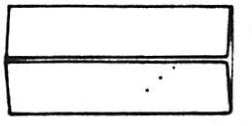
Open Frame II —Plain

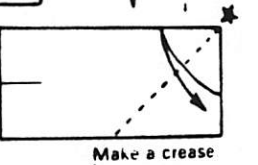
Although it is not as colorful as open frame I with the bow-tie motif, this revised unit manifests no bulging of individual sides. Consequently it is more versatile and can be assembled in a surprising number of ways



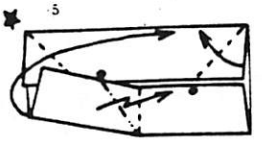
Open frame II, 20-unit assembly

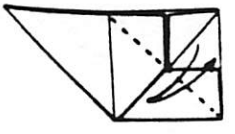




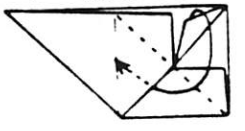


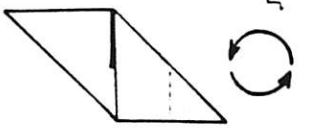
Make a crease



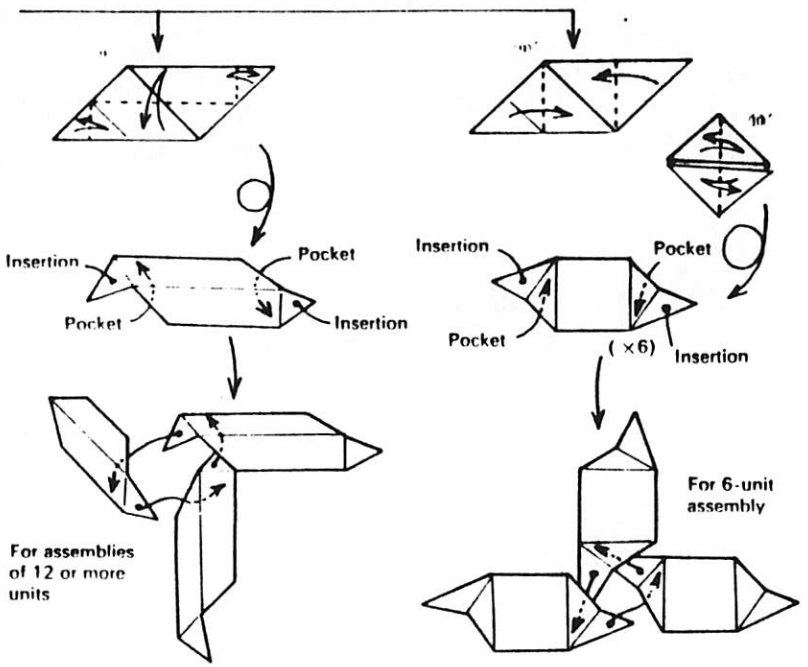


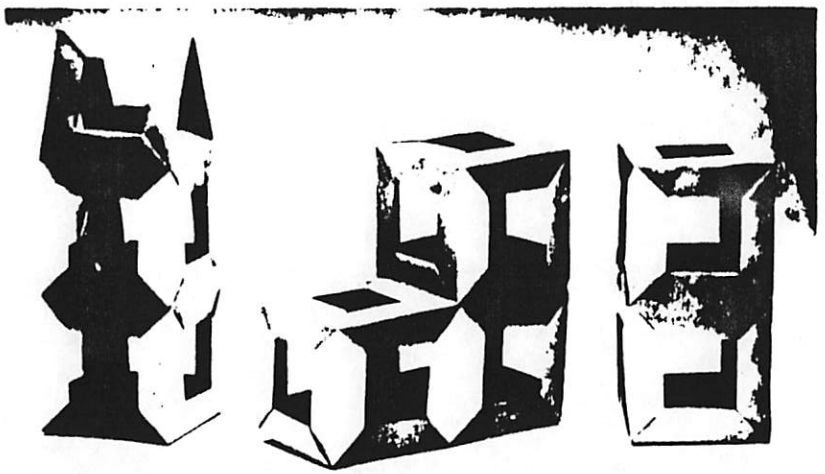
Insert and fold



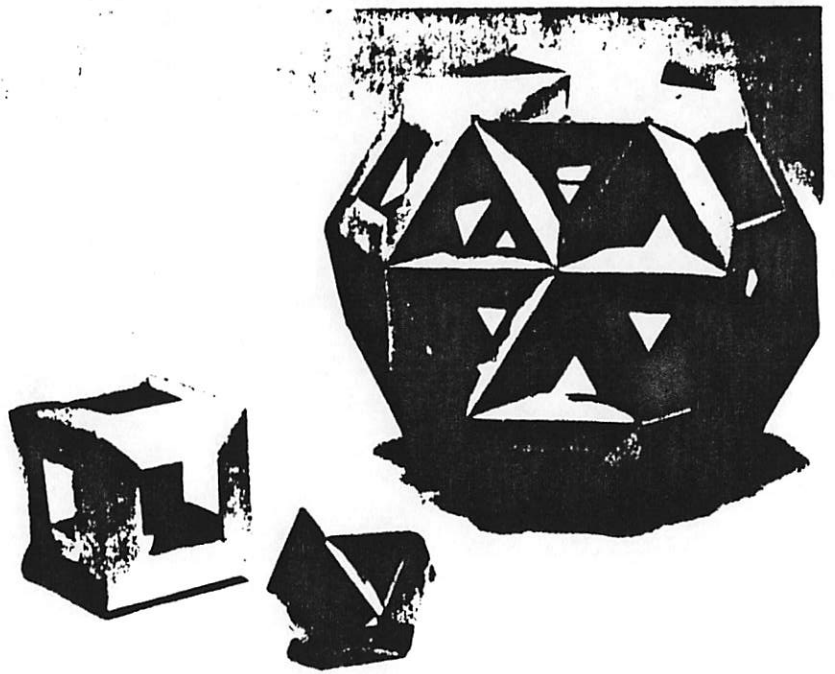


Continued on next page





Two-story tower with a pitched roof, 25-unit assembly (left); assemblies of 28 (middle) and 20 (right) units



Assemblies of 12 (left), 6 (middle), and 84 (right) units

Assembly of 28 units on p. 66, seen from a different angle

Multistory, towerlike structures with pitched roofs can be produced from open frame II in an almost architectural fashion. And creases can be added or not according to a predetermined architectural design.

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I would like to be involved in the following OCMC functions:

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Return to registration table when complete.

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HELP!! THERE'S A GREMLIN IN MY COMPUTER!!

LAST MINUTE
PROGRAM ADDITIONS AND CORRECTIONS:

10:00 - 10:55 Room 1

Kathleen Stanton, Math Games,
This session is geared to grades 1 - 4. There will be an additional session with the same games from 11:05 - 12:30.

11:05 - 12:30 Room HLG

Sally Melton, Rob McDonald, and Dennis McGeeney
Deal Me In
This session is geared to grades 3 - 6. The room has been changed.

11:05 - 12:30 Room H1
Juanita Walker, Make Math Meaningful
This room has been changed.

Conference Evaluation

In order to bring you a better conference next year, we need your input. Please circle a number and write comments and suggestions in the spaces.

WHAT GRADE LEVEL DO YOU TEACH? _____

	Low High
Was the selection of session topics interesting and diverse enough for you? (If you have certain topics you would like addressed next year or know of some excellent speakers - including yourself! - please state.)	1 2 3 4 5
How did you like the conference location (Irvine High School)?	1 2 3 4 5
How was registration handled?	1 2 3 4 5
Were the commercial exhibitors of value to you? (Please tell us of other exhibitors that you would like to see invited.)	1 2 3 4 5
How was the food? Morning snacks Lunch	1 2 3 4 5 1 2 3 4 5
How was the program brochure?	1 2 3 4 5
How do you like having the conference on a Saturday in early October? If this isn't good for you, please give us your preference.	1 2 3 4 5
What other kinds of events would you like to see OCMC sponsor in the future? Please be specific; we are planning for the Spring.	

Write additional comments on back.

Please place in the box at the registration table or mail to:

Sherry Skipper
1405 French St.
Santa Ana, CA 92701

GCMC 10/1/94 —

Elementary keynote —

Have to learn math so that you can telephone people." Family Circle.

Math Curriculum Cycles

1940-'56 ⇒ Basic Computation
'57 - 1960's — The "New Math"
1970's "Back to Basics"
1980's Problem solving ⇒ An Agenda for Action for the 80's
- Problem Solving
- Basics
- Assessment
- Higher level of Professionalism

1990's Math For All -
⇒ Technology / Globalization of Business

Shifts:
- classroom : = math community
- toward logical / math literacy
- Problem solving Cooperative learning Concrete Experience

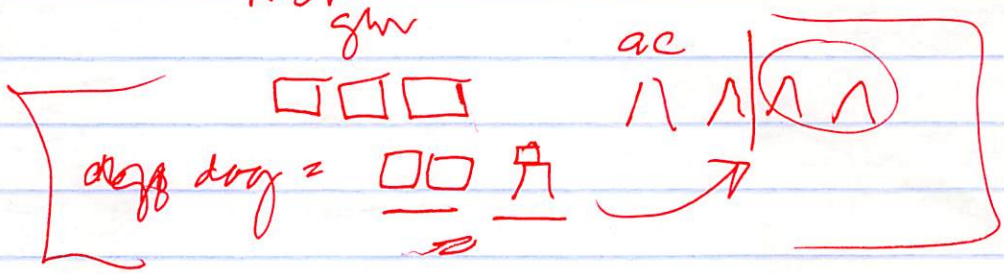
1998 = Framework

Mathematical Power for all.

relationship

5 = 4

$\frac{5}{20} = \frac{4}{20}$



- As I learn I ... mathematical teaching

$5g = 4h$ •

How do lessons look when we provide our students with the opportunity to do the thinking.

⇒ How to have/take a child - size circus!

lots of starting points